STRATEGIC DECISION BIAS BY ROLE IN FAILED TECHNOLOGY PROJECTS

By

Kenneth Rosson Pence

Thesis

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE

in

Management of Technology

August, 2003

Nashville, Tennessee

Approved:
David M. Dilts
William R. Mahaffey

ACKNOWLEGEMENTS

This research could not have been completed without the support of my advisor, Dr. David M. Dilts, who provided many insights and recommendations to foster this work. He always encouraged me during the many revisions. I would also like to thank my wife, Meredith DeVault, who was always sympathetic and supportive. Finally, I would like to thank the Metropolitan Nashville Police Department who provided such a fertile ground for research.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

ROLE PERSPECTIVES IN TERMINATED TECHNOLOGY PROJECTS

Research comparisons of decision-making differences based on role of the decision-maker within the organization are sparse and non- definitive. This research attempts to reveal strategic decision differences by looking at individual decision-making and common biases that may influence project terminations. This research is divided into two phases. The first phase is a survey instrument developed using a role bias macro model. Data is gathered from a population of executives and project managers who make strategic decisions based on the critical importance projects within their organizations (police, military and government contractors). The first phase of this research examines role-based differences in bias, uncertainty, and project scale.

The second phase of this research goes further to develop the executive scanning model by examining two concurrent projects. These case studies examine how data, revealed in the first phase of research (bias, uncertainty and scale), impacted two computer deployments in a public safety organization. One large project, a wireless, laptop computer deployment received acclaim and large productivity gains. The other project, a small, hand-held, wireless computer development project was under-cost but far over schedule and was terminated prior to final deployment. Both projects met the general goals outlined at their instigation but one was considered a dismal failure when compared to the success of the other project.

These two phases of research combine to develop a model of perspective bias that affects technology project terminations. This research will provide insight that may aid project managers when strategic "*go – no go*" decisions are about to made with technology projects.

CHAPTER II

THE DECISION TO FAIL

Research importance

Each year, billions of dollars are spent on technology projects; that are considered to be failures. In the most comprehensive study to date, the Standish Group found in 1997 that the United States allocated over $250 billion on Information Technology application development, spread over approximately 175,000 projects. Thirty-one percent (31%) of these projects will be considered failures, as they will be cancelled before they are completed[1]. Such project termination decisions are strategic decisions because they are: "important, in terms of the actions taken, the resources committed, or the precedents set (Mintzberg 1973)." While such decisions concern the total organization, they are still made by individuals; and individuals' perceptions may vary. The influence individual decision makers have in "failure" decisions may demonstrate that various positions within the organization, such as project manager or sponsoring executive, may impact the decisive factors in arriving at the termination decision.

Do project managers and executives evaluate a project differently when they decide to discontinue that project? Is the decision to terminate, a completely rational choice or do individual biases come into play, and, if such biases are present, are they influenced by the decision-maker's role or level in the organization? The purpose of our research is to investigate these questions.

Critical terms utilized in this study are defined as follows: A *technical project* is a series of tasks or activities to achieve a specific objective within certain specifications, within defined start and end dates, and subject to funding limits and resource availability (Nicholas 2001). *Failure of a project* is the discontinuation of a project before it achieves its complete implementation (Kumar, Persaud et al. 1996; Balachandra and Friar 1997). A project stopped (discontinued; terminated) after prototype testing, would be considered a terminated technical project. *Project managers* are those individuals directly responsible for the work efforts of the project team to achieve the project goals. *Executives* are any upper-level managers who have supervisory responsibility over project managers.

[1] Standish Group, December 1997

Failure as an outcome measure

While most decision-making research points to outcome measures of success since one tenet of management is that action should have some effect on performance (Dean and Sharfman 1996), the terms project "success" and "failure" are not definitive. Consequently we examined the literature regarding failure as an outcome measure. Kumar, Persaud and Kumar (1996) found little research agreement for definitions of 'success' or 'failure' in research and development projects (Kumar, Persaud et al. 1996). Their study yielded two significant findings for our research: (1) they defined *success* as project continuance and (2) they found that the decision to terminate projects came at different stages in the product/project life cycle. Other research was less than definitive on 'success' and 'failure'. Essentially, *failure* equated to project termination (varying levels of cost, effort associated with this termination determining the degree of failure) and *success* equated to project continuation (and ultimate completion of a product or project with varying degrees of success defined by user satisfaction, needs met and profitability to the organization). For examples, see: Pinto, 1990; Brockhoff, 1994; Balachandra, 1996, 1997; Kumar, 1997; Nellore, 2001; Pate-Cornell, 2001) (Pinto and Mantel 1990; Brockhoff 1994; Balachandra 1996; Balachandra and Friar 1997; Kumar, Persaud et al. 1997; Nellore and Balachandra 2001; Pate-Cornell and Dillon 2001). The project outcome macro model is presented in Figure 1.

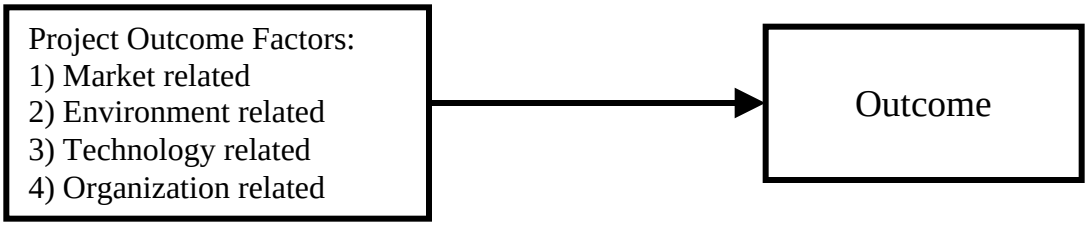

Figure 2. 1: Outcome Macro Model

Typically, such studies list various factors that influenced success or failure, with considerable overlap on influencing factors, depending on the background of the decision-maker and the outcome measures utilized. Most studies present a set of factors (both objective and

subjective) and attempt to relate them to a rational decision-making model with the typical goal of identifying critical factors leading to project success. Literature, concerning decision making, uses differing outcome measures: Burgelman (Burgelman 1985) refers to firm diversification by creating new venture divisions; Bukszar (Bukszar and Connelly 1988) queried return on investment scenarios; Daft (Daft, Sormunen et al. 1988) defined a firms' return on investment as the measure of success; Pate-Cornell (Pate-Cornell, Tagaras et al. 1990) used cash flow optimization; Thomas (Thomas, Clark et al. 1993) - used profitability of hospital services; Baskerville (Baskerville and Stage 1996) suggested to define expectations and measure progress; and Kumar (Kumar, Persaud et al. 1996) referred to 'successful' and 'unsuccessful' projects based on project continuance or cancellation; while Brown and Eisenhardt (Brown and Eisenhardt 1997) referred to multiple product innovations and increased company portfolios. It is difficult, if not impossible, to compare results that are based on both differing outcome measures and on the levels of such factors. Interestingly, absence of information lead to the determination of failure, that is, when success factors were not evident to the decision-makers, projects were considered failures (based on the outcome measures used). Individuals apparently decided different projects were ‘failures’ because they did not conform to *their preconceptions* of successful outcome measures. These were not *organizational* failure decisions but individual’s decisions concerning their perceptions of potential outcomes of the project.

Our study investigates the opposite end of the continuum from success: when a project is deemed to be a failure. While “success” tends to be measured by a wide range of objective measures, *failure* is an emotion-laden term meaning different things to different people (Simon 1955; Daft, Sormunen et al. 1988; Kumar, Persaud et al. 1996; Balachandra and Friar 1997; Nicholas 2001). All the project failure studies agreed on two points: (1) there are many factors affecting termination of projects and (2) these decisions to terminate occur at different points in the project development/deployment life cycle (Pinto and Mantel 1990; Kumar, Persaud et al. 1996; Balachandra and Friar 1997; Kumar, Persaud et al. 1997; Nellore and Balachandra 2001). In one of the most often cited in research, Balachandra’s review of termination factors, loaded on four factors (Balachandra and Friar 1997): (1) market related, (2) technology related, (3) environment related, and (4) organization related factors. Interestingly, none of these factors relate to individual decision-maker characteristics but do relate to factors individuals use to make

such decisions. Role of the decision-maker within the organization to bias a termination decision is not addressed.

Project failure literature (or success literature for that matter) tends to ignore the fact that the decision-maker's role in an organization, i.e., project manager or organization executive, may significantly affect perceptions of "success" or "failure;" despite the fact that decision-making research has demonstrated that the decision-maker's role in the organization has an impact on the decision to continue or cancel a course of action (Allison 1971; Allison and Zelikow 1999). No study adequately explains the differences in project and outcome measures related to either different positional perspectives or other perceptual viewpoints concerning the project. For example, do executives view projects that run over budget, more negatively than do project managers? From an executive's viewpoint, is a project that is over-budget, but on-time, less of a "failure" than a project that is 'on-budget' but has had a time overrun? Does the importance of these factors change depending upon project scale? Understanding these factors and the decision process would enable managers to have some control of the outcome (Simon 1982; Thomas, Clark et al. 1993; Dean and Sharfman 1996).

Individual Decision-Making and Project Outcome

Research on project success or failure generally uses a simple rational decision model (Gilbreath 1986; Brockhoff 1994; Balachandra and Friar 1997); however, as Simon (Simon 1955; Simon 1982) explained, most decision-makers develop a level of aspiration that they want to reach and a 'satisficing' answer, i.e. the first reasonable answer, will suffice. Within these bounds, individual decision-makers are rational. Figure 2.2 shows the bias macro model.

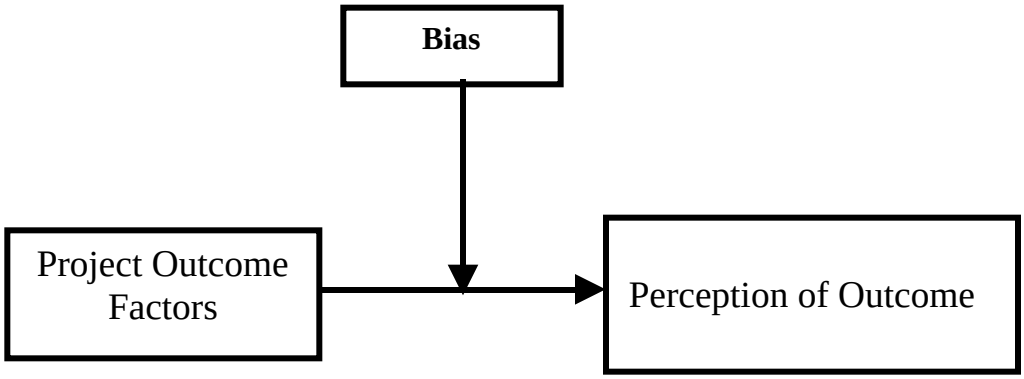

Figure 2. 2: Bias Macro Model

Because our research unit of analysis is the individual decision-maker who makes project termination decisions within an organization, we must review the literature on individual decision making. Management research deals with how decisions are made within organizations -- from the bounded rationality model of Simon (1955, 1982) to the 'sensemaking and sensegiving' model of Gioia and Chiddepeddi (1991). Both models have been examined by numerous authors (see: (Mintzberg 1973; Tversky and Kahneman 1974; Simon 1982; Burgelman 1983; Lengel et al. 1987; Eisenhardt 1989b; Orasanu and Connolly 1993; Baskerville and Stage 1996; Dean and Sharfman 1996; Bechara 1997; Allison and Zelikow 1999; Power 1999)). In Simon's rationality model, the individuals' decisions are presented as organizational or strategic decision making. His research investigates strategic decision making in an individual decision-maker's context and not in a group context. Allison (1977, 1999) developed one of the most crucial expansions of the rational decision rational actor model, as described above (Allison 1971; Allison and Zelikow 1999). He demonstrated that the *rational actor* model was not sufficient to explain critical decisions and showed how the *standard operating procedures* of an organization and the *individuals' perceptions* overlaid critical decisions. In expanding Simon's model, Allison includes positional bounded rationality through "conceptual lenses," where people make decisions based on 'where they are in a firm' using a combination of decision models (Allison 1971; Allison and Zelikow 1999). Little agreement exists on monolithic decision theories for organizations but many heuristic theories have been expounded. Adding the concepts of "sensemaking and sensegiving," to strategic decision-making takes Allison's 'conceptual lenses' of decision-making (Gioia and Chittipeddi 1991) a step further. This research blends the CEOs' information gathering aspects with how CEOs *interpret* information according to their job role in that organization. This individual *interpretation* of information is important because these individuals make decisions for their organizations.

Eisenhardt and Zbaracki (1992) reviewed the changes in strategic decision making (from 1963 to 1992) by examining strategic decisions made by top executives in their organizations. They summarized the bounded rationality variations and synthesized a blended model where decisions are a combination of bounded rationality and *political perspective* (Eisenhardt and Zbaracki 1992). Specifically, they contended that strategic decision making was a combination of bounded rationality while "the political perspective shapes the social context (Eisenhardt and Zbaracki 1992)." This suggests that individual perspective must affect critical decisions.

Interestingly, works by Daft (1988) and Thomas (1993) would have been useful, had it been available, to the Eisenhardt and Zbaracki study to posit how CEOs gather and interpret information on factors that affect an organization's performance (Daft, Sormunen et al. 1988; Thomas, Clark et al. 1993). We see that individuals make the strategic decisions for their organizations based on their interpretation (their perspective) of information.

Another model, the "strategy follows structure" model, describes decisions made by chief executive officers after feedback from mid-level managers (Burgelman 1983). Executives tend to turn to internal, personal sources of information when external sources of information have a high level of uncertainty (changing trends/changing technology) (Culnan 1983; Daft, Lengel et al. 1987; Daft, Sormunen et al. 1988; Cohen and Levinthal 1990; Werth, Strack et al. 2002). Again, research describes an interpretation of information by chief executive officers. Research on success and failure often cites interviews with company executives to obtain data on strategic decision making (Fischoff 1975; Tversky and Kahneman 1981; Burgelman 1983; Daft, Lengel et al. 1987; Daft, Sormunen et al. 1988; Gioia and Chittipeddi 1991; Eisenhardt and Zbaracki 1992). We see that *failure* may be a perception of decision-makers and individuals within an organization make strategic decisions. Interpreting information may then be based on how the information is presented according to the role of the decision-maker in the organization.

Interpretation and scanning

This interpretation of information is important because any decision to terminate reflects on the performance of the organization and the individual making the decisions; especially if information is framed differently to different persons due to their role (see Figure 2.3 below).

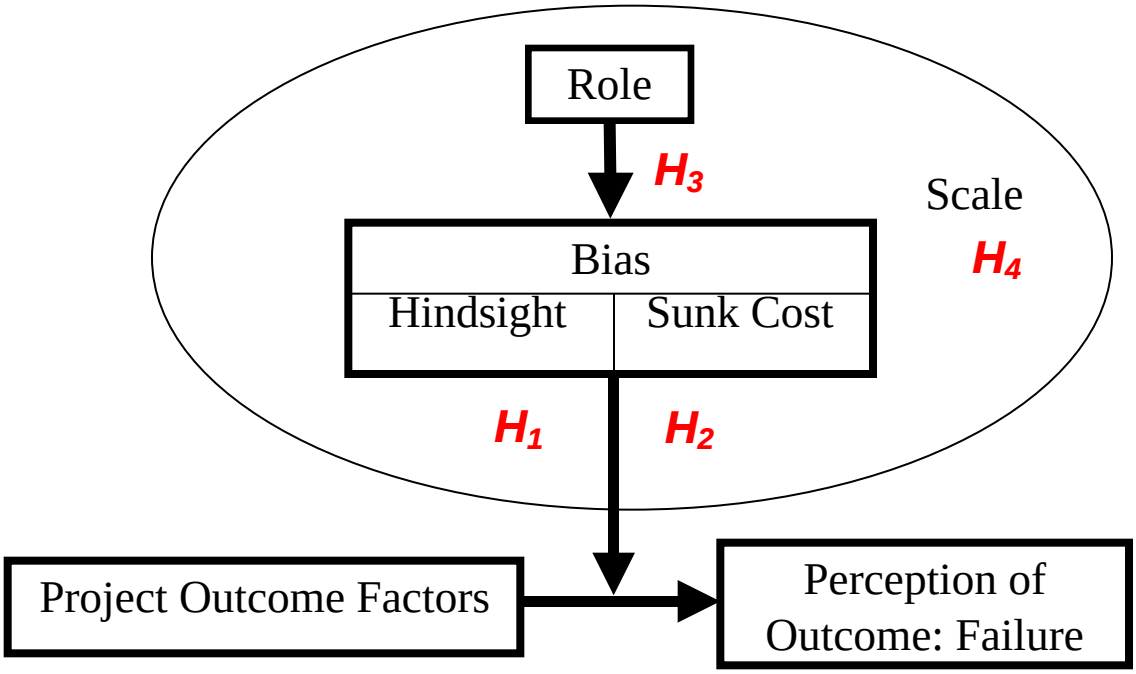

Figure 2. 3: Role-Bias Decision Model

There is a significant amount of research that demonstrates that many critical decisions, however, are based on incomplete information (Simon 1955; Allison and Zelikow 1999; Werth, Strack et al. 2002). Research has shown that decision-makers find it harder to obtain information when uncertainty is high (missing information, conflicting information and complex information (Bukszar and Connelly 1988; Daft, Sormunen et al. 1988; Eisenhardt and Zbaracki 1992; Schmitt and Klein 1996; Cole, Vaught et al. 1998). Daft, Sormunen and Parks showed how executives scan (search) more frequently for information when there is rapid change or high strategic uncertainty ("unstable, unpredictable external events" (Daft, Sormunen et al. 1988) for

their organization and call this behavior, environmental scanning. They then relate scanning to the performance of an organization. Both Burgelman and Daft refer to a bounded rationality model where facts are gathered and a decision is made in a linear, rational manner (Burgelman 1983; Daft, Sormunen et al. 1988). Thomas, Clark and Gioia (1993) refer to how upper management *interprets* the information it receives. Daft emphasizes how uncertainty complicates these decisions.

It appears that executives gather information by scanning and then interpret that information. What is not clear is if that interpretation is biased by their role in the organization. Kahneman and Tversky (1974, 1979, 1981) use prospect theory to demonstrate how decision-makers interpret information in a non-linear fashion. Instead of making the economically rational choice of balanced win-loss, decision-makers overweigh outcomes that were considered certain, relative to outcomes that were merely probable (Kahneman and Tversky 1979). Their research (Tversky and Kahneman 1974), and the work by Fischoff (1975), suggest that individuals make strategic decisions based on incomplete information that they interpret. We even see that they interpret information differently by the way it is presented. This interpretation from incomplete facts may lead to bias in a decision to determine if a project should be deemed a failure.

Bias

Bias may then become an important factor in the decision to terminate a project. Our research focuses on two types of biases: hindsight bias and sunk cost bias; which may differ according to the decision-makers' role in the organization. The first type of bias, hindsight bias, "is a person's tendency, after learning of a situation or the correct answer to a question, to distort a previous judgment in the direction of the new information (Fischoff 1975)." Fischhoff initially posited that when there was a distortion of earlier decisions, uncertainty about the earlier decision and knowledge of a correct answer biases any new decisions toward the correct answer. This "I knew it all along" effect was later identified in physician behavior when making diagnoses (Arkes, Wortmann et al. 1981). Surprisingly, the use of training to avoid hindsight bias did not result in less distorted decisions (Bukszar and Connelly 1988). Hindsight bias has been shown to increase (i.e., more distortion) when there are increases in uncertainty and/or over longer periods of time (Werth, Strack et al. 2002). Hindsight bias can also be caused by social

influence (Werth, Strack et al. 2002) when information forming the basis of the decision is gathered from other persons.

Sunk cost bias (also referred to as escalation of commitment) is the tendency to continue an activity once an investment in money, effort, or time has been made (Kahneman and Tversky 1979; Arkes and Blumer 1985). It appears, however, that time or *temporal investments* played little part and showed very little support for sunk cost effect (Soman 2001). Soman used an empirical study and shows that decision-makers do not have a mental accounting of time like they do with money. The clearest indicators of sunk cost effect are *level of effort indicators* (investments of money and effort) but it is not clear if, or how, other elements affect sunk cost bias. Sunk cost effect might then have an impact on project continuance. Conlon and Garland investigated just that topic by having subjects respond to a resource allocation scenario. This investigation found that prior estimates do not remove bias from later resource allocation decisions (Conlon and Garland 1993).

Explanatory research in escalation of commitment concentrates on two broad categories (Brockner 1992). First; expectancy theory, a predecessor to sunk cost and escalation of commitment theory, suggests that "decision-makers assess the probability that additional resource allocations will lead to goal attainment (Vroom 1964)." Expectancy theory strongly supports the existence of sunk cost bias. Second, cognitive dissonance theory posits "that decision-makers become entrapped in a previous course of action because of their unwillingness to admit – to themselves and/or others that the prior resources were allocated in vain (Festinger 1957)." Cognitive dissonance research strongly supports the presence of hindsight bias and is part of the foundation of hindsight bias theory. Expectancy theory research and cognitive dissonance theory both examine decision making in organizations and not the particular *role* of decision-maker within the organization. The role may affect the strategic decisions in an organization if the interpretation of information depends on how the information is presented and there is bias in the interpretation of incomplete facts.

We see that bias is present in strategic decisions. Further, individuals may exhibit sunk cost bias (escalation of commitment) when they have effort or resources invested in a project. Critical decisions can be biased toward known outcomes (hindsight bias) and training cannot overcome this trait. Scanning for information has been shown, at least with executives, to increase when there is increased uncertainty or changes within a project or organization. Longer

time intervals tend to exacerbate hindsight bias. These perspective biases affect critical project termination decisions that would certainly classify as strategic decisions for an organization. It is any comparative differences in these perspective biases that we examine.

Role in the organization

With regard to the potential impact of an individual's role in a decision, key research on management decisions that impact success or failure of projects generally investigates *CEO*s (Kahneman and Tversky 1979; Arkes and Blumer 1985; Gioia and Chittipeddi 1991; Eisenhardt and Zbaracki 1992). Yet research on project failure generally investigates information provided by project managers (Pinto and Mantel, 1990; Kumar, Persaud and Kumar, 1996; Balachandra and Friar, 1997). In one unique study, Duchon, Dunegan, and Barton (1989) queried engineers, scientists and managers of a high-tech engineering firm to determine how their decision making affected research and development allocation decisions (scenarios) (Duchon, Dunegan et al. 1989). These study participants demonstrated serious decision framing or hindsight bias; some decision-makers stated they did not wish to appear wasteful of money, time or effort so they reported they would continue unfruitful projects. The continuance of projects because of a previous level of effort investment is indicative of *sunk cost bias* not hindsight bias. Instead of simply looking at external factors affecting resource allocation decisions, this research examined the decision process as well. While hindsight bias and sunk-cost bias appeared intertwined; it was not clear how (or if) these biases related to each other but bias appears with executives and project managers.

Decisions moderated by the *position* of the decision maker (who is framing the decision) show that an investment in an endeavor appears to create a sunk cost effect when estimating the probability of success of that enterprise (Allison 1971; Arkes and Blumer 1985; Eisenhardt and Zbaracki 1992; Allison and Zelikow 1999; Arkes and Hutzel 2000). The role of the decision-maker within the organization should then be important in estimating sunk cost effects.
We now have the disparate pieces of decision-making theory necessary to construct a reductionist model: individuals make decisions for organizations based on, often incomplete, or conflicting information, which they interpret. Factors for this interpretation may be weighed differently (bias) depending on their job role or level within an organization. We will use the

Daft executive scanning model as it shows how project importance, complexity and the rate of technology affect the amount of uncertainty in project terminations (Daft, Sormunen et al. 1988).

Hypotheses

We suspect that hindsight bias might affect executives' and project managers' decisions in project terminations. Previous research indicated that project terminations are based on incomplete information and often occur as a result of uncertainties in the environment (Bukszar and Connelly 1988; Balachandra 1996; Kumar, Persaud et al. 1996; Kumar, Persaud et al. 1997).

Hypothesis 1: *Decision makers are affected by hindsight bias in technical project terminations.*

Previous research demonstrates, in general, that sunk cost bias increases when there is considerable investment of effort and money (Arkes and Blumer 1985; Conlon and Garland 1993; Soman 2001). Soman's research demonstrates a strong correlation between money expenditures and sunk cost bias compared to calendar time (temporal investments) (Soman 2001).

Hypothesis 2: *Decision makers are affected by sunk cost bias in technical project terminations.*

Changes in levels of effort expended should not be an important decision factor if the project to be terminated is closer to completion than inception, unless sunk cost bias is a factor. Our research seeks to reveal if larger projects are treated differently than smaller projects in the eyes of executives and project managers (Daft, Sormunen et al. 1988), in other words, if there is a scale effect. Should 'large' and 'small' projects be perceived as similarly important in comparison to perception of large and small projects within that organization?

We suspect the project-terminating upper management executive or the project manager who was terminating a project (or having a project terminated by managers at a higher level in the organization) will have different perspectives regarding the termination.

Hypothesis 3: *Role in the organization affects bias in a project termination decision.*

H3a: *Role in the organization affects the type of bias in a project termination decision.*

H 3b: *Role in the organization affects the level of bias in a project termination decision.*

Other research demonstrates that executives scan for information more frequently during periods of high uncertainty, hindsight bias increases as the time increases between initial critical decisions and during reevaluation of those decisions (Fischoff 1975; Kaempf, Klein et al. 1996; Schmitt and Klein 1996; Klein 1998). Project managers could be affected by hindsight bias by overestimating project success when their level of effort was high (a tie-in to sunk cost effects perhaps). Our research predicts that decision-makers would scan frequently for information when the environment was changes rapidly (at the time just prior to project termination) unless the decision-makers have already 'reevaluated their earlier decisions' - *i.e.* hindsight bias can be inferred. Increases in the rate of scanning for information have been shown to occur when there is increased uncertainty. The termination of a project should be a period of high uncertainty when people are shuffled back to other duties or laid off and where other resources are re-allocated. Hindsight bias exists therefore when a person, who has instigated or continued a project, decides to stop that project without scanning for additional information.

Hypothesis 4: *Scale affects the termination decision in projects (Control).*

Scale is operationalized using project size, cost and number of personnel involved in the terminated project.

We test the null hypotheses of these four (4) hypotheses.

Methodology

Our research population focuses on organizations that face rapid change, increased uncertainty (Tversky and Kahneman 1974; Fischoff 1975; Culnan 1983; Eisenhardt 1989b; Balachandra and Friar 1997) and high risk of failure (Eisenhardt 1989b; Pinto and Mantel 1990; Balachandra and Friar 1997). We studied organizations that must *deploy* advanced technologies

(chemical and weapons detection, communications, biometrics, armor, and less-lethal weaponry) due to their high-risk decision-making requirements. Specifically, we investigate terminated projects in the public safety sector, where an incorrect decision can lead to loss of life or loss of freedom.

Instrument Development

A survey instrument was developed from the Daft executive scanning behavior model which demonstrated how executives gather information for their organizations (Daft, Sormunen et al. 1988). Failure literature provided the critical termination factor questions and bias literature provided questions on level of effort (sunk cost) and hindsight bias which were used to develop our hypotheses (Pinto and Mantel 1990; Kumar, Persaud et al. 1996; Balachandra and Friar 1997). To investigate these hypotheses, a survey instrument was developed with questions related to organizational demographics and having the respondents self-define large and small projects according to monetary cost and personnel assigned. Additional data on project scale included total estimated project cost, number of full-time employees, and scheduled time for completion of a terminated project.

Two questions in our survey instrument compared initial project scanning to scanning when a project was about to be terminated. A five point Likert scale, similar to Daft's (Daft, Sormunen et al. 1988) research on executive scanning, was used; *i.e.* scan less than once a year (essentially never) to daily scan for information (often).

Operationalization

This research defines factors that would give indications of biases. Hindsight bias increases (more distortion) when there are increases in uncertainty and over longer periods of time (Werth, Strack et al. 2002). An increase in uncertainty provokes more scanning (more frequent rate of scanning) for information (Daft, Sormunen et al. 1988). A critical element in hindsight appears to be *when* the information is obtained for making a decision. This is interesting because agreement in the causative factors related to project terminations generally refers, not to fixed levels of project data (i.e., the total project cost or time), but to changes in resources or *attitudes* toward, or in, a project (Henderson 1990; Zirger and Maidique 1990; Brockhoff 1994; Balachandra 1996; Kumar, Persaud et al. 1996; Balachandra and Friar 1997).

Rapid changes in resources and attitudes would cause increased uncertainty when a project is evaluated for a termination decision (reallocation of resources alone covers personnel, finances, equipment and material). The *start of a project* and the time *just prior to termination of a project* would, therefore, be times of great uncertainty (due to contemplated changes). Greater levels of uncertainty just prior to termination should cause an increase in scanning rates. A decrease in scanning rates in a period of high uncertainty would indicate a "knew it all along" effect or a discounting of an earlier decision to proceed with the project. Decreases in scanning just prior to termination would therefore indicate a 'hindsight bias' effect. Logistic regression demonstrates that there are distinct differences by role of the decision-maker

Operationalization of sunk cost bias was similar. Escalation of commitment (or sunk cost bias) increases with investments of effort and money – level of effort indicators (Arkes and Hutzel 2000). The *X-axis* refers to the hindsight bias factor (component loading from scanning at project initiation and just prior to termination). The *X-axis* refers to level of effort factors (factor reduction of man-hours of effort and money expended). Research shows that as the amount of effort/money expended increases, *sunk cost bias* increases (Tversky and Kahneman 1974; Arkes and Blumer 1985; Duchon, Dunegan et al. 1989; Arkes and Hutzel 2000; Soman 2001); and as time increases, *hindsight bias* increases (Tversky and Kahneman 1974; Fischoff 1975; Kahneman and Tversky 1979; Tversky and Kahneman 1981; Werth, Strack et al. 2002) . Previous research demonstrates that while there is a joint impact of increasing effort and time, the impact of time on 'sunk cost bias' is not as great as its impact on *hindsight bias* (Soman 2001).

To address how far the project had progressed by asking, "What percent of the project had been completed?" Asking; "What percent of the total planned budget had been spent?" – allows the determination of the expenditure level. These gave levels of completion by budget and man-hours of effort expended. Questions were also asked to determine the importance of the respondent's level of effort (man-hours of effort, money expended, and calendar time) were asked using a seven point- Likert importance scale.

Our model incorporates changes in project termination factors. Specifically, we investigated the following critical factors:

1. Change in initial project expectations (Kumar, Persaud et al. 1996; Balachandra and Friar 1997)
2. Change in overall project importance to the organization (Kumar, Persaud et al. 1996)
3. Change in need for the project (by the organization) (Kumar, Persaud et al. 1996; Balachandra and Friar 1997)
4. Change in overall complexity (Brockhoff 1994; Pate-Cornell and Dillon 2001)
5. Change in overall time to completion (Pinto and Mantel 1990; Brockhoff 1994; Balachandra and Friar 1997)
6. Change in user needs (Brockhoff 1994; Balachandra and Friar 1997)
7. Change in overall project resources (people, material, funds) (Brockhoff 1994; Arkes and Hutzel 2000; Pate-Cornell and Dillon 2001; Soman 2001)
8. Change in technical difficulties (Pinto and Mantel 1990; Kumar, Persaud et al. 1996; Pate-Cornell and Dillon 2001)
9. Change in funding *source* (Pate-Cornell, Tagaras et al. 1990)
10. Change in regulatory problems (Balachandra and Friar 1997)
11. Internal politics (within the organization) (Burgelman 1983; Miller and Reuer 1996; Balachandra and Friar 1997; Allison and Zelikow 1999)
12. External politics to the organization (Burgelman 1983; Balachandra and Friar 1997; Allison and Zelikow 1999)
13. Change in commitment by project champion (Pinto and Mantel 1990; Gioia and Chittipeddi 1991; Brockhoff 1994; Kumar, Persaud et al. 1996; Balachandra and Friar 1997; Allison and Zelikow 1999)

These factors were necessary to evaluate level of sunk-cost bias and, in the previous hypothesis, hindsight bias.

These two survey instruments were developed further to capture information from executives and project managers of terminated projects. For both, organizational demographics and critical termination factor questions were rated for importance on a seven-point Likert scale: (1= Not important to 7= Extremely important). The questions are identical except questions on the executive questionnaire referred to the project manager's importance in the termination decision.

Conversely, the project manager's questionnaire referred to the executive's importance in termination decisions.

Pre-test

Pre-test instruments were given to university engineers (instructors/graduate students -- systems engineers). As a result of the pilot survey, definitions of terms were added and several questions were rewritten to clarification. For example, it was discovered that there is no clear definition of an ”upper management project champion,” hence we defined the project champion as *an upper management individual who would sponsor or support a particular project.*

Pilot test

Printed survey instruments (the pilot-test) were given randomly to engineers and executives at a large (5,000+ member) communications/technology convention in Nashville, Tennessee (Association of Public-Safety Communication Officials - August 2002). The pilot test checked for major flaws in the questionnaire and helped determine a potential rate of non-response bias. These groups at Nashville contained representatives from private and governmental entities. They shared the common trait that they all deployed, or sought to deploy, new innovative products.

Sixty-eight persons were asked to respond to the pilot test and were interviewed briefly. They were given surveys with self-addressed, stamped envelopes for their responses. Because several persons mentioned that they had never terminated a project, they are not included in the sixty-eight. Thirteen of the sixty-eight individuals responded within two weeks and four more responded during the month that followed. Results of the pre-test indicated that we could expect approximately a twenty-five percent (25%) usable response rate. Pre-test results revealed that minor changes needed to be made to clarify information on the 'number of personnel assigned to a project' and how 'employees' were defined. Initially, there was no information on the survey instrument to show 'frequency of scanning'; this element was added to coincide with questions on the executive scanning research by Daft and in order to define a measure of hindsight bias (Daft, Sormunen et al. 1988). The printed surveys were converted to the web format for ease of respondent use.

Sample

The sample population consists of project managers, engineers, executives and researchers who deploy new technologies (new technological processes, methods, materials, or products) when there is a high rate of technological change to test the role-bias macro model comparing strategic decision-makers from different roles within the organization. The sample frame was chosen from government agencies, private contractors, researchers and the military that deployed technological projects in the past or were currently attempting to deploy technical projects. We were seeking to gather data from a sample frame that deployed new technologies for use in critical situations and changing environments. They manifest project importance (incarceration or deadly force, high complexity (many integrated components and agencies), and a high rate of change of technology (rapidly changing standards, threats, user needs). The technology sector was the only sector tested with the Daft executive scanning behavior.

Two anonymous web-based surveys were developed. Approval was obtained to administer the instrument in November 2002 from the Independent Review Board. Originally the survey was sent to 318 email addresses of government (civilian and military) agencies, government contractors, researchers with practical experience and companies seeking to deploy innovative products. Invalid addresses and company policy forbidding responses to surveys, reduced the sample frame to 218. We received 69 responses but 12 were unusable because the respondents had never terminated a project and 3 were incomplete. Thirty-two (32) respondents were project managers and twenty-four (24) respondents were from upper management executives. The response rate of twenty-five percent (25%), in usable responses, coincided with the pre-test's response rate.

Analysis and Outcome

To test for inference of hindsight bias (*Hypothesis 1*) we used two methods. First, one would expect the scanning frequency to increase due to the uncertainty (incomplete information) when deciding when to discontinue a project (just prior to project termination). The difference in the scanning rates establishes hindsight bias: scanning early in the project was more frequent than scanning immediately prior to termination. The earlier decisions would be overwritten as time passed. Results of the Pearson product moment correlation is .513, with a two-tailed significance of .002 (n=35).

Next the rate of scanning (hindsight factor) was plotted against the project calendar time expended, by role in the organization to see how they relate to each other. The *Y-axis* refers to the hindsight bias factor (component loading from scanning at project initiation and just prior to termination). The *X-axis* refers to the calendar time used by the project so far. This comparison graph was to demonstrate any role differences in hindsight bias affecting executives and project managers (Figure 2.4).

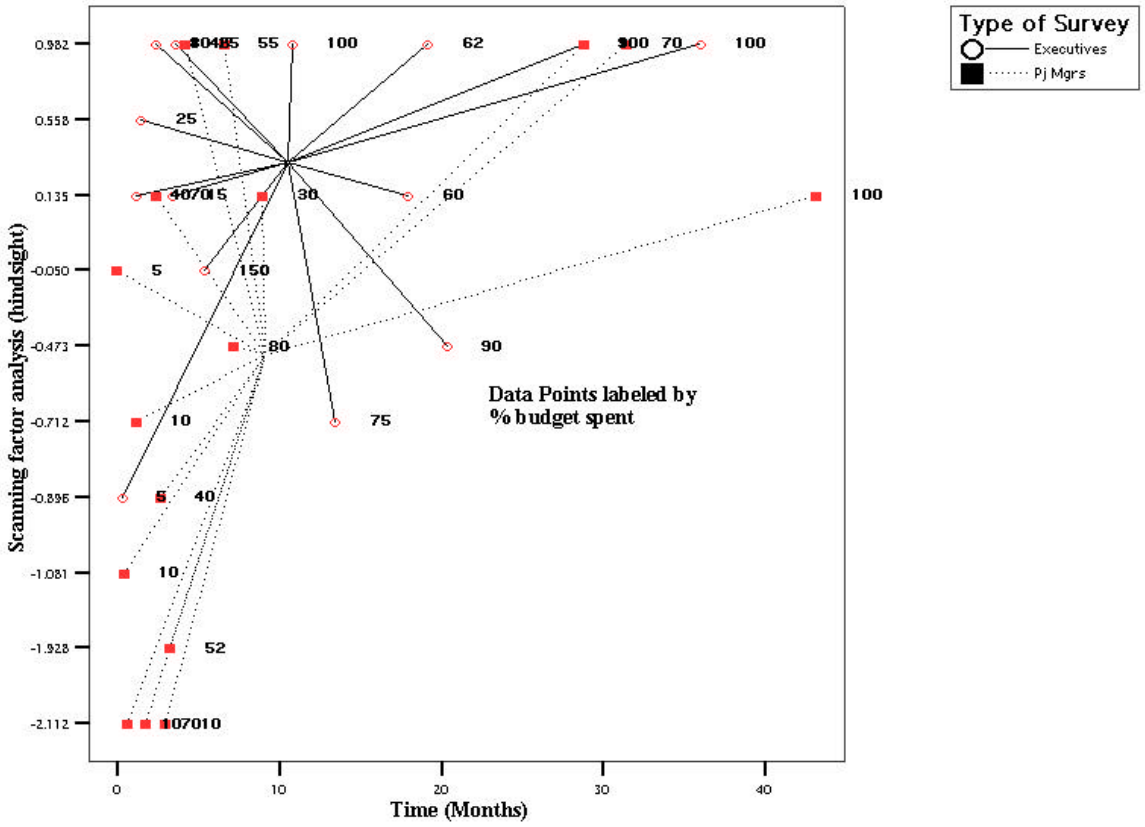

Figure 2. 4: Scanning Factor (Hindsight by Role) vs. Calendar Time

To investigate sunk-cost bias (H_2) we begin by looking at those factors that can be considered *effort*. Time or temporal investments show little support for sunk cost effects compared to monetary investments (Soman 2001). Therefore a factor reduction of level of effort (percentage of man hours spent and money expended) in a project should be a good indicator of sunk cost effects. Principal component analysis show how level of effort factors load on one

component (Table 2.1). Scale reliability tests showed the factor reduction was very reliable (Chronbach's Alpha = .8668 and Hotelling's t^2 = .0000).

Table 2. 1: Level of Effort Principal Component Analysis

Item	***Component***
Level Effort (man hrs) expended Project Team	.866
Level Effort (man hrs) expended by Project Manager	.835
Level Effort (man hrs) by upper management	.780
Amount of money already expended	.761
Amount of calendar time already used	.799

This component loading provided a continuous variable for 'sunk cost effect'. This component factor was then plotted against time by role of the decision-maker within the organization (executive or project manager). The *X-axis* refers to temporal investments or calendar time. The *Y-axis* refers to level of effort factors (factor reduction of man-hours of effort and money expended). How then does an individual's role in the organization (our unit of analysis) relate to bias in termination decisions? This is the fundamental question we strive to answer, after accounting for extraneous factors (Figure 2.5 – next page).

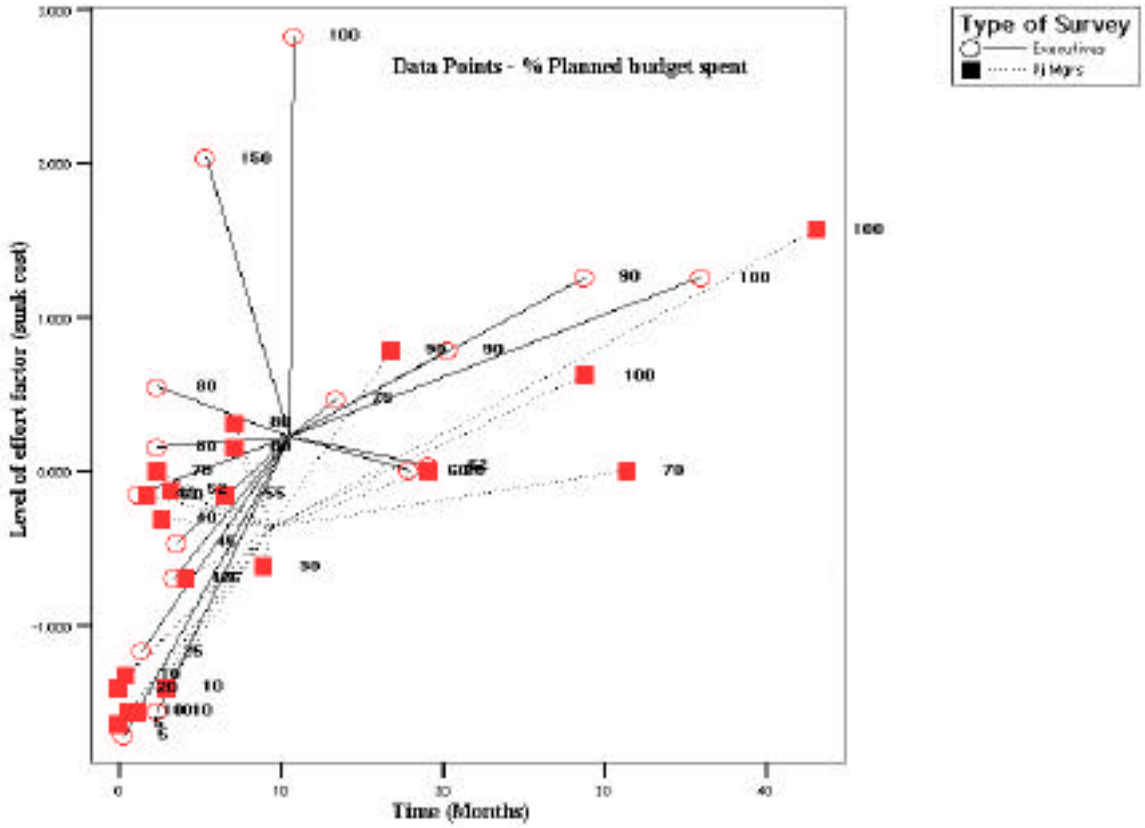

Figure 2. 5: Level of Effort (by Role) vs. Project (Calendar) Time

Next the level of effort (sunk cost) factor was plotted against the hindsight bias factor by role in the organization to see how they relate to each other. The *X-axis* refers to the hindsight bias factor (component loading from scanning frequency at project initiation and just prior to termination). The *Y-axis* refers to level of effort factors (factor reduction of man-hours of effort and money expended). This comparison graph was to demonstrate any role differences in biases affecting executives and project managers (see Figure 2.6 on next page).

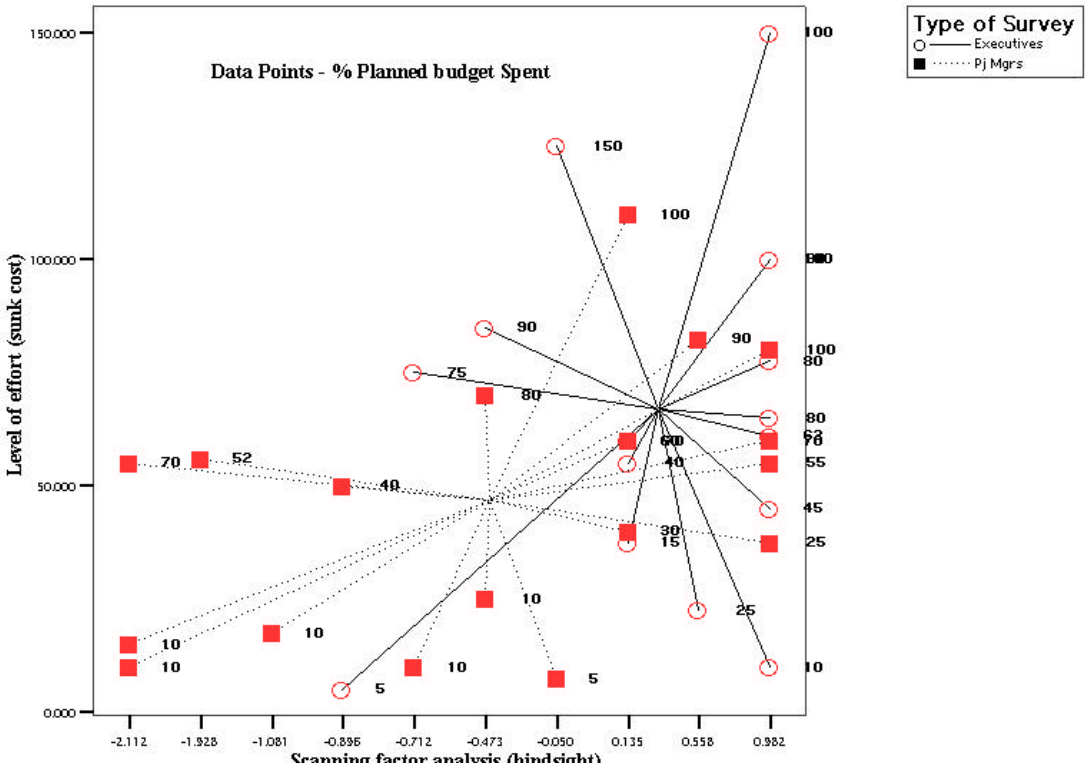

Figure 2. 6: Level of Effort vs. Scanning Factor

We integrated the research agreement on sunk-cost and hindsight bias by positing the simple matrix form in Figure 2.7 below.

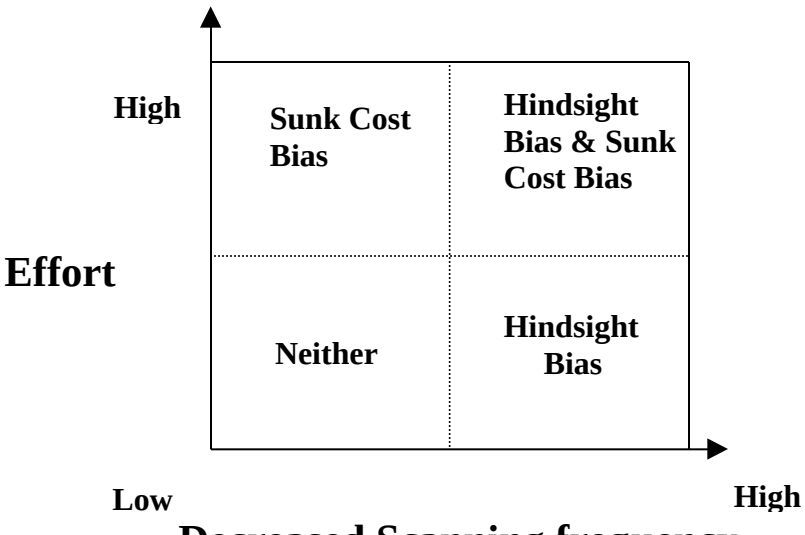

Figure 2. 7: Perspective Bias Matrix

This evidences that personnel would be extremely unlikely to scan more frequently just prior to termination of a project. Hindsight bias can then be inferred due to the difference in the scanning rates: scanning more frequently early in a project than just before making a termination decision. There is a strong statistical significance, but hindsight bias only explains 51% of the variance.

Hindsight bias was indicated at the termination decision, but without consideration of the role of the decision-maker. We then divided the loading matrix of the four reduced critical termination factors (4) into four groups: organizational, environmental, technical, and importance to the firm (grouped) factors to examine component correlation. When the critical factors were reduced, they explained 72% of the variance between the factors for executives and 70% of the variance between factors for project managers. Principal component loading shows definite differences using critical termination factors by role (executives and project managers - see Table 2.2 & 2.3).

Table 2. 2: Principal Component Analysis of Critical Factors in Termination: *Executives* ORDER

		Organization	Environment	Technology
1	Funding problems	**.839**	-.418	.039
2	Change in user needs	**.777**	.466	-.262
3	Change project importance to organization	**.767**	.211	-.308
4	Change in project champion commitment	**.736**	-.298	-.101
5	Change in resources (people, funds, material)	**.715**	-.264	.250
6	Change in need for project by organization	**.622**	.603	-.083
7	External Politics (outside organization)	**.597**	-.535	.004
8	Regulatory Problems	**.559**	.069	.435
9	Change in Project complexity	.453	**.794**	.126
10	Technical difficulties with the project	.410	-.307	**.605**
11	Project took too long (time) to complete	-.084	.043	**.896**
12	Change in Initial project expectations	-.188	.476	**.647**

Table 2. 3: Principal Component Analysis of Critical Factors in Termination: *Project Managers*

EXEC ORDER

		Organization	Environment	Technology	Importance
11	Project took too long (time) to complete	**.781**	.209	.272	.028
9	Change in Project complexity	**.684**	-.196	.352	-.156
2	Change in user needs	**.682**	-.426	.033	.015
4	Change in project champion commitment	**.621**	.003	-.319	-.446
8	Regulatory Problems	**.610**	.241	-.468	-.020
1	Funding problems	**.536**	.650	-.109	.120
5	Change in resources (people, funds, material)	.101	**.867**	.299	.136
12	Change in initial project expectations	.467	**-.558**	.411	.103
10	Technical difficulties with project	.497	.056	**.620**	.188
6	Change in need for project by organization	.476	-.370	**-.517**	.341
3	Change project importance to organization	.358	.048	-.335	**.678**
7	External Politics (outside organization)	.477	.145	-.205	**-.547**

Indicators of sunk cost bias (time, effort and money expended) tested in hypotheses 2 should be more pronounced later in a project than earlier in the project -- if they existed. Each respondent indicated how far a project had progressed before its termination by stating the percentage of project completion and the percentage of budget that had been spent. These responses were divided into two groups: fifty percent completion, or less, before termination (*early termination*) and more than fifty percent completed before being terminated (*late termination*). The level of effort factor (refer back to Table 2.1) was then compared to the early and late termination groups.

We used the median percentages level of the project budget spent (by executives and project managers) to define early and late termination as well as median percentage of total project completion. We then compared the level of effort (reduced) factor to early and late terminations to determine if there were any inferences of 'sunk cost' effect. No statistically significant effects using a Pearson correlation were noted by early or late project termination for executives (percentage of project completion, budget spent or man hours expended) compared to their level of effort indicators (time, effort, or money)**.** Project managers, however, showed

significance (Pearson correlation) with level of effort indicators when comparing early versus late termination according to budget spent for the terminated project. Project managers showed the following correlation with early versus late termination: the combined sunk cost factor (by principal factor analysis of level of effort indicators) is significant correlated to early and late termination based on budget (Pearson correlation .426* p=.019 n=30). While a sunk cost effect indicator is present for project managers, it is not significant for executives, when compared to early and late project terminations.

Table 2. 4: Level of Effort correlated to scale - Based on Budget (Early v. Late term)

Respondent		
Executives	Pearson Correlation	-.028
	Sig. (2-tailed)	.908
	n	20
Project Managers	Pearson Correlation	.426*
	Sig. (2-tailed)	.019
	n	30

We then examined the data to determine if project scale effects play a role in termination decisions when correlated with the level of effort. It would seem that project scale does not affect the critical termination factors of regulatory problems, funding issues, politics, or changes in project complexity, initial project expectations, complexity, or technical difficulties. It seems, however, that biases based on perspective affect these termination factors.

Five (5) level of effort factors were first reduced by principal component analysis to a single factor (see Table 2.1). Scale effects on termination decisions (*Hypothesis 4*) would be shown by defining large, middle-sized, and small projects according to each organization's own description. Then scanning frequency change (hindsight) and level of effort (sunk cost) indicators were used to compare projects of different scales (large, middle-sized or small). Individual respondents self-determined if a project was considered large or small according to the monetary amount of a project and the number of personnel working full time on the project.

Terminated projects were divided into three groups: large (as defined by the individual as a large project for their organization, n=12), small (as defined by the individual as a small project for their organization, n=12), and middle-sized projects (projects that fell between the two definitions n=14).

The bias perspective factors identified had no significant correlation to scale effects monetarily. This mirrors Daft's findings where he states "the effect (scale effect by return on investment - ROI) is small and not statistically significant (Daft, Sormunen et al. 1988)." Turning to the other measure of scale, "employees assigned to the terminated project" (scaled according to responses of large, small, or middle-sized employee size) was not significantly correlated with scanning frequency changes (hindsight) or with sunk-cost effects. Scale does *not* appear to be a factor when considering termination decisions.

We then compared the correlation of these grouped critical project termination factors. Perspective differences were striking. Executives showed the strongest correlation when they thought "the project took too long to complete." Taking too long was positively correlated to changes in initial expectations. This is further evidence that executives, when faced with projects that "last too long," are increasing affected by hindsight bias. Project managers, however, considered projects taking too long as an organizational issue. Project managers considered that the more things changed (changes in resources (Pearson correlation = .867) or funding sources (Pearson correlation = .650), the less likely they were to want a change in initial project expectations (Pearson correlation = -.588). This demonstrates that if a project has to change its funding source or gets more (or less) resources, the project manager does not want the initial project expectations to change (rise or fall).

Striking differences in perception of critical termination factors exist between executives and project managers. Executives list resource importance in the organization factor group (.715); yet project managers list resource importance importantly in the environmental factors group (.867). Executives list changes in project complexity in the environmental factors group (.794); project managers place complexity in the organizational factors group (.684). Clear differences in perspective exist (Tables 2.2 & 2.3). There are a few similarities: executive and project managers look similarly at changes in user needs and the importance of the commitment of the project champion. Both decision-makers (roles) consider the importance of changes in resources (people, funds, & material). Executives are acutely aware of resources (.715) and

funding sources (.839) for their projects but are more interested in how long the project takes (Pearson correlation =.896) – than funding sources.

Discussion and Conclusions

Not surprisingly, our research supports a number of previous results. Literature shows that termination of a project is equated with project discontinuance and success is equated with project continuance.

Notably, the scale of a project is not a factor in the role except for a negative correlation for project managers in amount of money spent in late terminations. This may just be another sunk cost effect. The significance of scale is surprisingly absent from any correlation with other important factors, namely: changes in (internal/external) politics, technical difficulties, regulatory problems, project complexity, user needs, time to completion, and project resources (no matter what the size of the project). This finding supports Daft's earlier work (Daft, Sormunen et al. 1988) where he found that scale was not a significant factor affecting performance.

Our findings are applicable to both practicing project managers and to the research community. It is vital for project managers to understand that small projects are just as important as large projects to executives. Project managers should not be less concerned with the termination of a project simply because its budget is smaller than a large project. When determining if a project is to be terminated, small projects are not seen differently from large projects in the eyes of executives. Our research establishes that objective data for termination decisions is viewed differently depending on a person's role or level in the organization.

There appears to be strong evidence to support *perspective bias* by positional role in decision-making within organizations. The rational actor model of individual decision-making does *not* sufficiently explain how termination decisions are made. Factors that affect success or failure of a project are not simply tallied up to reach an outcome. Our research supports political (or perspective) aspects of termination decision-making similar to Allison's research on the role of the decision-maker and Eisenhardt's political view of decision-making (Eisenhardt and Zbaracki 1992; Allison and Zelikow 1999). Their research blends bounded rationality, the rational actor model and politics (perspective). Decision making in project termination combines

gathering and weighing of information by the persons gathering the information. Decision-makers, based on their respective role in the organization, exhibit *perspective bias*.

Executives appear to make decisions based on decision framing (i.e., how the facts and ideas are presented to them). Executives tend to weigh initial expectations heavily. The executives showed a strong, statistically significant correlation between variables *the initial project expectations* and *the project took too long to complete.* Hence, projects that lengthen their completion will also have higher executive expectations.

Table 2. 5: Job Role Differences in Perspective Bias

Executives	Project Managers
Sunk Cost Effects	***Sunk Cost Effects***
· Cumulative – possibly include their workers	· Personal effort drives effects
Hindsight Bias Effects	***Hindsight Bias Effects***
· Higher than PMs	· Less effect than Execs
· Change in initial projections causes	
· Greater bias in overdue projects	
Scale effects	***Scale effects***
· Little support for scale	· Later stages of a projects may be affected by amount of budget expended

The project managers' responses did not show this correlation. Project managers see the project taking too long as an organizational issue. Project managers must be aware that they will be held accountable for the expectations they set at the initial stages of a project.

Executives also appear to invest more effort at initial stages of a project and gather less information when a project is about to be terminated. This hindsight bias manifests itself as a component of the technical factors group for executives.

Hindsight bias increases with time (Fischoff 1975; Kaempf, Klein et al. 1996; Werth, Strack et al. 2002) so project managers must realize that executives are more likely to rethink their earlier decisions with *less* information scanning as the project progresses. Projects that take

longer than initially projected are more important to executives than projects that go over budget (though budget was still of import to both groups).

There is strong empirical support for 'sunk cost bias' by project managers when projects are in later stages when they are terminated; however, there appears to be little 'sunk cost effect' by executives -- even at later stages of project terminations. Executives report larger levels of effort than do project managers. Executives appear to be reporting total man-hours and not *their* individual effort. This reporting may be a cumulative effect that is not demonstrated in project managers. Project managers seem to be more focused on the project budget ("percentages of budget") and the level of effort expended by their project team than on any timetable.

Implications of these sunk-cost bias effects are meaningful because project managers exhibit bias related to the project's budget but executives do not. Project managers can then get 'caught up' in budgetary sunk-cost bias if they exercise a considerable level of effort, especially in later stages in a project. Project managers must expect to be affected by sunk-cost bias whenever they put forth-considerable effort on a project. They, however, should understand that executives focus on the initial expectations for the project. Project managers should refrain from overly optimistic projections. Lingering projects will not be examined favorably by executives. The (perspective) of success of a project may hinge on the presentation to upper management staff concerning both time to completion and budget. Project managers should remember that executives are very sensitive to missing time gates and overly optimistic projections.

Overall, executives seemed more concerned with changes from their initial expectations and project managers were more concerned with whatever steps used to "finish" a project without going over budget. It was interesting to note that project managers would be overly optimistic with projections of success and training did not mitigate this tendency when there was a large level of effort investment. The executives included the level of effort of their project teams and showed higher levels of effort than the project managers but were more likely to rethink earlier decisions than project managers.

Implications for Research

Uncertainty played a part in our findings; it may be based on the role of the information gatherer in the organization. How executives and project managers gather information, how frequently, and what sources they use may play an important part in the decision and whether a

project is deemed a success or failure. One of the difficulties our research faced was the heterogeneity of definitions of "success." Definitions of success for projects should be researched to standardize outcome measures. Current measures are widely diversified, making 'success' a nebulous term. There is much room for varying degrees of success or failure if success is simply defined as project continuation and failure is simply defined as discontinuance. Standardization of outcome measures would clarify comparisons of factors that lead to success or failure.

Sample size was a concern in this study. Further research should use larger samples of executives. Some respondents related (in the comment section of the survey) that their organization did not like responding to surveys about failure. Questions related to success, as well as failure of projects may allow broader investigations in the future. We have shown that perspective bias does exist. Further research needs to investigate the effect of role-based communication on decision-making.

Individuals make strategic decisions within an organization. Any research that does not include perspective differences is incomplete. In accordance with the decision-making literature, we found that individuals gather information and then interpret such information based on their level or role in the organization. Additionally, organizational role or level makes a difference with regard to the importance of initial expectations. Project managers tend to focus on budget and give projections of success biased by the effort; they and their team have expended. Executives are affected by the way progress or reevaluations of the project are framed for them throughout the life of the project. Interestingly, small projects are no different than large projects when it comes to a termination decision. If a manager does not take perspective bias into account, what could have been a successful project may lead to the 'decision to fail'.

References

Allison, G. T. (1971). Essence of Decision: Explaining the Cuban Missile Crisis. Boston, MA, Little, Brown.

Allison, G. T. and P. Zelikow (1999). Essence of Decision: Explaining the Cuban Missile Crisis.

Arkes, H. and C. Blumer (1985). "The Psychology of Sunk Cost." Organizational Behavior and Human Decision Processes **35**(1): 124 - 140.

Arkes, H. R. and L. Hutzel (2000). "The Role of Probability of Success Estimates in the Sunk Cost Effect." Journal of Behavioral Decision Making **13**(3): 195-306.

Arkes, H. R., R. C. Wortmann, et al. (1981). "Hindsight bias among physicians weighing the likelihood of diagnoses." Journal of Applied Psychology **66**: 252-254.

Balachandra, R. (1996). "A Comparison of R&D Project Termination Factors in Four Industrial Nations." IEEE Transactions on Engineering Management **43**(1): 88-96.

Balachandra, R. and J. Friar (1997). "Factors for Success in R&D Projects and New Product Innovation: A Contextual Framework." IEEE Transactions on Engineering Management **44**(3): 276 - 287.

Baskerville, R. L. and J. Stage (1996). "Controlling Prototype Development through Risk Analysis." MIS Quarterly **20**(4): 481-505.

Bechara, A., Damasio, H., Tranel, D., Damasio, A. (1997). "Deciding advantageously before knowing the advantageous strategy." Science **275**(5304): 1293 - 1294.

Brockhoff, K. (1994). "R&D project Termination Decisions by Discriminant Analysis- An International Comparison." IEEE Transactions on Engineering Management **41**(3): 245-254.

Brockner, J. (1992). "The Escalation of Commitment to a Failing Course of Action: Toward Theoretical Progress." Academy of Management Review **17**(1): 39-61.

Brown, S. L. and K. M. Eisenhardt (1997). "The Art of Continuous Change: Linking Complexity Theory and Time-Paced evolution in Relentlessly Shifting Organizations." Administrative Science Quarterly **42**(1): 1-34.

Bukszar, E. and T. Connelly (1988). "Hindsight Bias and Strategic Choice: Some Problems in Learning from Experience." Academy of Management Journal **31**(3): 628-641.

Burgelman, R. A. (1983). "A Model of the Interaction of Strategic behavior, Corporate Context, and the Concept of Strategy." Academy of Management Review **8**(1): 61 - 70.

Burgelman, R. A. (1985). “Managing the New Venture Division: Research Findings and Implications for Strategic Management.” Strategic Management Journal **6**(1): 39-54.

Chang, A. and H. Vanharanta (1996). A Hyperknowledge Environment to Support Strategic Decision Making. 29th Annual Hawaii International Conference on System Sciences, Hawaii.

Cohen, W. and D. Levinthal (1990). “Absorptive Capacity: A New Perspective on Learning and Innovation.” Administrative Science Quarterly **35**(1): 128 - 152.

Cole, H., C. Vaught, et al. (1998). “Decision Making During a Simulated Mine Fire Escape.” IEEE Transactions on Engineering Management **45**(2): 153 - 162.

Conlon, D. E. and H. Garland (1993). “The Role of Project Completion Information in Resource Allocation Decisions.” Academy of Management Journal **36**(2): 402-413.

Culnan, M. (1983). “Environmental Scanning: the Effects of Task Complexity and Source Accessibility on Information Gathering Behavior.” Decision Sciences **14**: 194 - 206.

Daft, R., R. Lengel, et al. (1987). “Message Equivalency, Media Selection, and Manager Performance: Implications on Information Systems.” MIS Quarterly.**11**(3): 355-366.

Daft, R., J. Sormunen, et al. (1988). “Chief Executive Scanning, Environmental Characteristics, and Company Performance: An Empirical Study.” Strategic Management Journal **9**(2): 123 - 139.

Dean, J. W. J. and M. P. Sharfman (1996). “Does Decision Process Matter? A Study of Strategic Decision-Making Effectiveness.” Academy of Management Journal **39**(2): 368 - 396.

Duchon, D., K. Dunegan, et al. (1989). “Framing the Problem and Making Decisions: The Facts are Not Enough.” IEEE Transactions on Engineering Management **36**(1): February 1989.

Eisenhardt, E. M. and M. J. Zbaracki (1992). “Strategic Decision Making.” Strategic Management Journal **13**(Special Issue): 17-37.

Eisenhardt, K. M. (1989b). “Making Fast Strategic Decisions in High Velocity Environments.” Academy of Management Journal **32**(3): 543-576.

Erev, I., G. Bornstein, et al. (1993). “The negative effect of probability assessments on decision quality.” Organizational Behavior and Human Decision Processes **55**(1): 78 - 94.

Festinger, L. (1957). A theory of cognitive dissonance. Evanston, IL, Row, Peterson.

Fischoff, B. (1975). “Hindsight≠foresight: The effect of outcome knowledge on judgment under uncertainty.” Journal of Experimental Psychology: Human Perception and Performance **1**(3): 288 - 299.

Gilbreath, R. (1986). Winning at Project Management: What Works, What Fails, and Why. Project Management for Business and Technology. J. Nicholas, 2001. New York, Prentice Hall. **2nd:** p.314.

Gioia, D. A. and K. Chittipeddi (1991). "Sensemaking and Sensegiving in Strategic Change Initiation." Strategic Management Journal **12**(6): 433-448.

Glaser, B. G. (1992). Basics of grounded theory analysis. Mill Valley, CA, Sociology Press.

Henderson, R. a. C., Kim (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. Strategic Management of Technology and Innovation, 2001. R. Burgleman, Maidique,M.,Wheelwright, Steven. New York, McGraw-Hill/Irwin. **3rd:** 448-461.

Kaempf, G. L., G. Klein, et al. (1996). "Decision making in complex command-and-control environments." Human Factors **38**(2): 220-231.

Kahneman, D. and A. Tversky (1979). "Prospect theory: An Analysis of Decision Under Risk." Econometrica **47**(2): 263 - 291.

Klein, G. (1998). Naturalistic Decision Making by experienced persons. Sources of Power: How People Make Decisions. Cambridge, Massachusetts, The MIT Press**:** 330.

Kumar, V., A. Persaud, et al. (1996). "To Terminate or Not an Ongoing R&D Project: A Managerial Dilemma." IEEE Transactions on Engineering Management **43**(3): 273 - 284.

Kumar, V., A. Persaud, et al. (1997). "Stopping an R&D Project." IEEE Potentials **16**(2): 13 - 16.

Kunreuther, H., J. Linnerooth, et al. (1984). "A Decision-Process Perspective on Risk and Policy Analysis." Management Science **30**(4): 475 - 485.

Lipshitz, R. and O. B. Shaul (1997). Schemata and mental models in recognition-primed decision making. Naturalistic decision making. C. Z. a. G. K. (eds.). Mahwah, N.J., Erlbaum**:** 293 - 304.

Miller, K. and J. Reuer (1996). "Measuring Organizational Downside Risk." Strategic Management Journal **17**(9): 671-691.

Mintzberg, H. (1973). "Strategy-Making In Three Modes." California Management Review **16**(2): 44 - 53.

Mintzberg, H., D. Raisinghani, et al. (1976). "The Structure of 'Unstructured' Decision Making." Administrative Science Quarterly **21**(2): 246 - 275.

Nellore, R. and R. Balachandra (2001). “Factors Influencing Success in Integrated product Development (IPD) Projects.” IEEE Transactions on Engineering Management **48**(2): 164-174.

Nicholas, J., 2001 (2001). Project Management for Business and Technology. New Jersey, Prentice Hall.

Orasanu, J. and T. Connolly (1993). The Reinvention of Decision Making. Decision Making In Action: Models and Methods. G. Klein, Orasanu, J. , Calderwood,R., Zsambok,C.E. Norwood, N.J., Ablex**:** 3 - 20.

Pate-Cornell, M. E. and R. L. Dillon (2001). “Success Factors and Future Challenges in the Management of Faster-Better-Cheaper Projects: Lessons Learned from NASA.” IEEE Transactions on Engineering Management **48**(1): 25-34.

Pate-Cornell, M. E., G. Tagaras, et al. (1990). “Dynamic Optimization of Cash Flow Management Decisions: A Stochastic Model.” IEEE Transactions on Engineering Management **37**(3): 203 - 212.

Pennington, N. and R. Hastie (1993). “Reasoning in explanation-based decision making.” Cognition **49**: 123 - 163.

Pinto, J. and S. Mantel, Jr. (1990). “The Causes of Project Failure.” IEEE Transactions on Engineering Management **37**(4): 269 - 276.

Power, D., J. (1999). A Brief History of Decision Support Systems, DSSResources.COM. 1999.

Schmitt, J. F. and G. Klein (1996). Fighting in the fog: Dealing with battlefield uncertainty. Marine Corps Gazette**:** 62-69.

Simon, H. A. (1955). “A Behavioral Model of Rational Choice.” The Quarterly Journal of Economics **69**(1): 99-118.

Simon, H. A. (1982). Models of Bounded Rationality. Behavioral Economics and Business Organization. Cambridge, MA., MIT Press.

Soman, D. (2001). “The Mental Accounting of Sunk Time Costs: Why Time is not Like Money.” Journal of Behavioral Decision Making **14** (3): 169-185.

Thomas, J. B., S. M. Clark, et al. (1993). “Strategic Sensemaking and Organizational Performance: Linkages among Scanning, Interpretation, Action and Outcomes.” Academy of Management Journal **36**(2): 239 - 70.

Tversky, A. and D. Kahneman (1974). “Judgment under uncertainty: Heuristic and biases.” Science **185**(4157): 1124 - 1131.

Tversky, A. and D. Kahneman (1981). “The Framing of Decisions and the Psychology of Choice.” Science **211**(4481): 453 - 458.

Vroom, V. (1964). Work and motivation. New York, Wiley.

Werth, L., F. Strack, et al. (2002). “Certainty and Uncertainty: The Two Faces of Hindsight Bias.” Organizational Behavior and Human Decision Processes **87**(2): 323 - 341.

Zirger, B. and M. Maidique (1990). “A Model Of New Product Development: An Empirical Test.” Management Science **36**(7): 867 - 883.

CHAPTER III

THE TALE OF TWO PROJECTS: BOTH SUCCESSFUL, ONE A FAILURE

Introduction

What causes project managers and executives to evaluate a project and arrive at radically different perceived outcomes? Two technology deployments of varying sizes of scale in terms of cost and manpower requirements are examined to determine how executives and managers cope with high levels of uncertainty when evaluating success. The projects started in the same organization at approximately the same time with the same project manager. One project was a small technology development project and the second was a large, fairly straightforward technology deployment. While the projects were independent, and were viewed that way by the project manager, executives weighted the rapid progress of the large project against the slow progress of the smaller. Why then did the project manager view each project as a success because each achieved their initial goals, while executives arrived at the conclusion that one was a success, while the other was a failure?

Project managers[2] often deal with concurrent projects and perform technological risk assessments. Project managers tend to assess risks from the bottom line -- cost and profits expected -- and have a focused view of the technologies and resources for their project(s) (Pate-Cornell, Tagaras et al. 1990). This focused view tends to isolate each project from concurrent projects.

Executives[3] consider the broader, strategic interests of the company (Daft, Sormunen et al. 1988). Their opinions, however, may be impacted by results or progress of other projects. It is this influence, this weighting of information, cum; this bias that may affect the perception of success or failure. The executives in an organization generally approve the initiation of any project and oversee its general progress, so it is incumbent upon the project manager to be aware of forces that may render their project anything less than a success.

[2] Project Managers are those individuals directly responsible for the work efforts of the project team to achieve the project goals.

[3] Executives in our context are any upper-level manager who has supervisory responsibility over project managers.

One important factor that may impact a decision-maker's view of a project is hindsight bias (Bukszar and Connelly 1988; Fischer 1995; Schweitzer and Cachon 2000; Werth, Strack et al. 2002). Hindsight bias "is a person's tendency, after learning of a situation or the correct answer to a question, to distort a previous judgement in the direction of the new information" (Werth, Strack et al. 2002). Hindsight bias increases, i.e., causes more distortion, as time increases between initial decision and final assessment. Additionally it increases in uncertain environments (Fox and Tversky 1998; Werth, Strack et al. 2002). While hindsight bias may be a characteristic of both executives and project managers, it is the executive's biased viewpoint that portends a project's success and, hence, their evaluation of the project manager's handling of the project.

A second factor that impacts decision-makers is 'sunk cost' bias that appears to exacerbate over-estimation of success (Arkes, Wortmann et al. 1981; Arkes and Blumer 1985; Fox and Tversky 1998). The sunk cost effect is the strong tendency to continue an activity once an investment in money, effort, or time has been made (Kahneman and Tversky 1979; Fox and Tversky 1998; Arkes and Hutzel 2000). Project managers may not want to end an unproductive activity or communicate increased uncertainty to upper management because they either do not want to appear wasteful or they fear repercussions. Failure of project managers to communicate with upper management, due to 'sunk cost bias' would increase uncertainty for upper management because it would deprive them of important facts and information.

Interestingly, such an increase in uncertainty tends to block decisions (Schmitt and Klein 1996; Klein 1998) and increases hindsight bias (Werth, Strack et al. 2002) for executives in an organization. The perspective difference between the executives and project managers hence may cause executives to withdraw support from a project, further crippling that project, or censure the project participants. Failing to factor in the executive perspective by the project manager places a project's *perceived* success at risk (Culnan 1983; Daft, Lengel et al. 1987; Daft, Sormunen et al. 1988; Duchon, Dunegan et al. 1989; Ashmos, Duchon et al. 1998). Because executives are bombarded with ever increasing amounts of information, management decisions are not always based on in-depth knowledge but, instead, on the executive *perspective* of the facts (Daft, Sormunen et al. 1988; Duchon, Dunegan et al. 1989; Ashmos, Duchon et al. 1998).

Decision Perspective Theory

Decision makers make decisions in today's complex environment from accessible information. Decisions are difficult to make due to the uncertainties of missing information, conflicting information and complex information (Daft, Sormunen et al. 1988; Eisenhardt and Zbaracki 1992; Schmitt and Klein 1996; Ashmos, Duchon et al. 1998; Cole, Vaught et al. 1998). Fischhoff (Fischoff 1975) posits that when there is a distortion of earlier decisions, hindsight bias stems from uncertainty. Additionally, Tversky and Kahneman (1981) show that people decide based on how outcomes are presented (Tversky and Kahneman 1981). Decision framing, as they call it, is easily influenced by how information is worded. Werth, Strack, and Forster (2002) go further to say that hindsight bias may be caused by social influence when information is gathered from other persons (Werth, Strack et al. 2002).

If how information is worded and presented (decision framing) greatly affects decisions, then it should be important how project managers present project information and how executives interpret that information. Indeed, Daft, Sormunen, and Parks (1988) show that executives scan (search their environment) for information (Daft, Sormunen et al. 1988; Ashmos, Duchon et al. 1998; Werth, Strack et al. 2002). and tend to turn to internal, personal sources of information when external sources of information have a high level of uncertainty (changing trends/changing technology) (Cohen and Levinthal 1990; Eisenhardt and Zbaracki 1992). It is the Daft executive scanning model that we adapt to aid in interpretation of these cases. Daft, Sormunen and Parks posited that the rapidly changing environment (especially the technical environment) impacts uncertainty and executives search for information (scanning) to make strategic decisions. We add the role of the decision-maker within the organization and suggest that the level of effort, of the individual, also affect the interpretation of the facts. The executive scanning model was to make decisions to improve the return on investment and showed how uncertainty increased executives' scanning frequency. This scanning and role bias indicators let us define an expanded model (see Figure 3.1 – Role-Bias Decision Model) using "perceived outcome" as the measurement of success or failure.

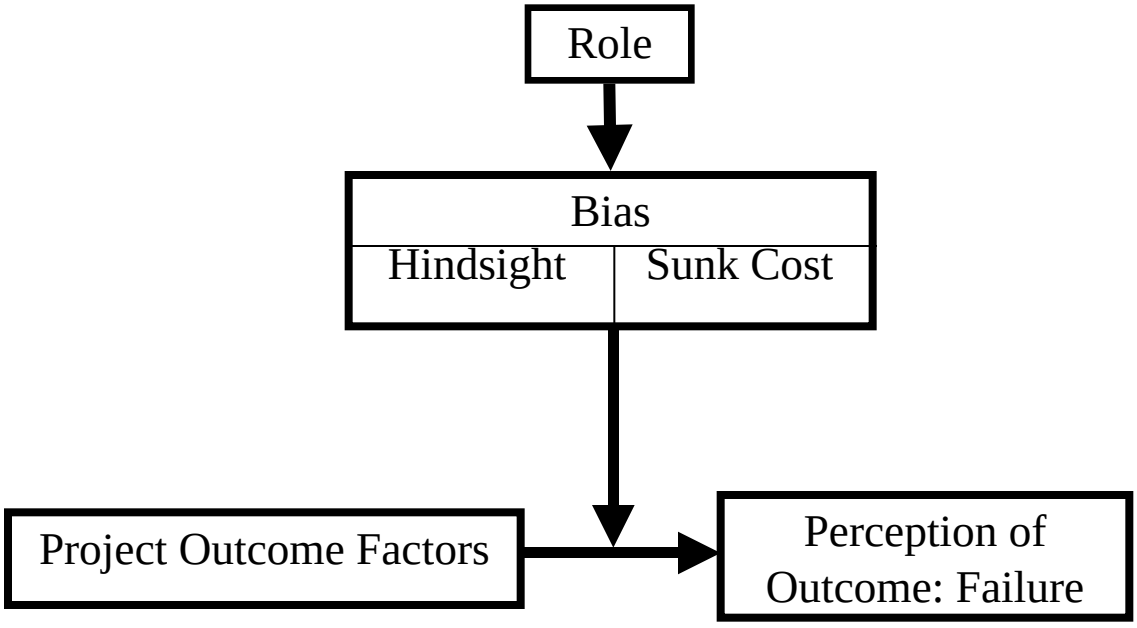

Figure 3. 1: Role-Bias Decision Model

On the other hand, project managers tend to focus on completing technology development and deployment projects within budget when the technology is not mature or nonexistent. The 'throw it over the wall' concept implies a great deal of uncertainty and risk which project managers attempt to minimize. While known risks can be acknowledged and mitigated in some instances, Schmitt and Klein (1996) and Lipshitz and Shaul (1997) have shown that uncertainty tends to 'block' action (Schmitt and Klein 1996; Lipshitz and Shaul 1997). These case studies show that the outcomes or progress of concurrent projects within an organization impact role-based decision making and can explain this increase in uncertainty and increase in project risk.

Methodology

Using the case study processes developed by Yin (1994) and Eisenhardt (1989), we analyze two cases of project decisions for high-risk projects. This was a multiple-case, embedded design and it was completed to discover if and why sunk cost and hindsight bias were present in such projects and if such biases are dependent upon the role of the decision makers in the project (Eisenhardt 1989; Yin 1994). Data was collected in real-time during the entire life of both projects.

The settings are a major metropolitan city-county in Tennessee covering 533 square miles. The organization studies, the Metropolitan Nashville Police Department, employs over 1,300 sworn officers and over 400 civilians support staff. They actively search for and receive federal dollars to support their activities. Because of the critical nature of the tasks performed by such high risk decision makers there were certain unique project requirements. Among these were requirements for high data accuracy, encryption, reliability, and durability to near-military specifications.

Of particular importance for our research is that there are at least two distinctions mobile officers. The first are those who primary duty is in automotive vehicles and second are those assigned to walking, bikes, motorcycles or horses (other-mobile). There are approximately 700 vehicle officers and 120 other-mobile officers. The automotive vehicle officers are the user community for the large, laptop project. The hand-held users are those in the second group.

Case Studies

Two concurrent projects were implemented to give wireless data capabilities in a high risk environment, namely police personnel. The 'large' project studied was the deployment of two hundred and sixty-nine (269) wireless laptops supported by a commercial cellular data network. A multi-year state grant and coordinated federal grants funded the deployment for personnel in cars. The project will be referred to as the *laptop* project in this report. This project had a cash match from other sources of 25%

The ‘small’ case project examined was to develop design-driven prototypes of a wireless, hand-held computer platform by taking off-the-shelf hardened wireless computers and having some simple software written for them. This project is referred to as the *hand-held* project. Over time the scope of this project changed dramatically and the project manager modeled the payback of the grant match money as the main risk -- solely the financial risk. This project faced a long (15-month) initial start delay, a major technology shift, and then a total change in project direction to meet moving user requirements. Cash match was ten percent (10%) in this project.

The Metropolitan-Nashville Police Department initiated the smaller project, the Police Hand-held Project, through a grant with The United States Office of Science and Technology (OST), a sub-unit of the National Institute of Justice (NIJ). The Police Planning and Research Division of the Metropolitan Nashville Police Department was to administer the hand-held grant

in the summer of 1996. The hand-held project, a tenth the size of the larger project, was to help develop a commercial product and software that would solve police issues with having readily available information accessible to mobile personnel.

There was a concurrent planned deployment of wireless laptops using the same commercial cellular digital packet data (CDPD) system in early 1997 and 1998 as would the hand-helds. These wireless laptops were to be deployed in stages in police vehicles. Metropolitan Nashville Police officers newly assigned to walking, bicycles or motorcycles needed a means, other than voice transmissions over VHF frequencies, to access police information (similar to the wireless laptops that were being introduced during the same period). The Hand-helds would be a further deployment of wireless infrastructure support for officers who couldn't carry laptops. The end-user requirements were developed in 1996 as follows but turned out to be a moving target as the technologies matured.

The small, hand-held project, initiated in 1996, was finally completed in 2001 while the large, laptop project began at the same time, came to initial success in only 4 months, and is continuing to be deployed.

The larger project was to deploy hardened, touch-screen laptops in police cars throughout a county covering 533 square miles of varying terrain. The laptops would wirelessly connect to local, state and federal computers (plus each other and surrounding computers). All queries and later photographs would be encrypted and transmitted over a commercial, cellular digital packet data (CDPD) system. Equipment was ordered, received, and installed on deposit of grant funds. Users were trained and one hundred users were operational four months after the receipt of funds.

(early 1996): Identification of end-user requirements:

(Hand-held Project) Mobile officers (Walking, horse, bike patrol and solo motorcycle officers) were polled regarding what features they would want in a data device. In summer of 1996 officers were asked about a hand-held device with the following pre-determined functional capabilities:

- Perform encrypted wireless queries of local state and Federal information (same as laptops
- Recognize (hand written) printed input (laptops had convenient keyboards
- Take police reports
- Print out citations

Officers were asked to specify desirable characteristics, including; durability, weight, size, interface (How you'd operate it), battery life, cost (compared to radios). The informal surveys reached consensus on the following points among the intended users:

- Durability: "We should be able to drop if off our belt and it still works."
- Weight: "It should weigh, not much more than, the police radios."
- Size: "Not much bigger than a ticket book or VHS tape."
- Interface: "No 'dinky' buttons… lighted when we need it… want to be able to write on it and not correct EVERY word… easy to use."
- Battery life: "Needs to work when we do -- all shift -- 8.5 hours."
- Availability: "We are desperate for it now. Don't tell us what we can have it in three years (prophetic statement here - author's note)…whatever we get will be 'old hat' in three years anyway."

Selection of hardware, operating systems were made after reviewing literature and handling many current devices.

In July 1996 the Police Planning and Research Division saw a live demo of a Digital Ocean Seahorse (hardened handheld computer) using a CDPD wireless connection, sending email and using the Internet. This software and hardware was selected as they met the initial criteria. The decision to choose the integrator was made from a suggestion of a development firm that had a "good reputation." The initial decision was made between the owner of the proposed development company and the project manager. The final decision was accepted during an eight (8) minute, long distance phone call and two emails (after the initial month of planning). The decision to submit the grant application was made by the Chief of Police (equivalent of the CEO) and the financial officer (CFO) after a brief review of the grant proposal. The Office of Science and Technology (OST) awarded the grant March 1, 1997, 5 months after the May 1996 submission. The money for the handheld (smaller) project was not available to spend until August 1997, nearly 15 months after the initial request.

The first delay in the small case caused another 'go- no go' decision: should the grant be pursued after the long (15 month) delay from initial application? The project was continued after discussions with potential integrator about implications to technology change. Executives gave a perfunctory 'go ahead' to pursue the project but were not privy to the technical discussions.

(Large project) One hundred (100) wireless laptops were deployed in March, 1997 in the larger project. User acceptance and favorable press simply made prospective users of the smaller project more anxious for parity. Executives seemed pleased by the positive results from the

larger project initial results and were noncommittal about funding delays with the smaller project.

To aid in understanding the case, we will discuss it using the timelines found in Figure 3.2. For ease in understanding the timeline we discuss the relevant dates and then discuss the major events of each project beginning with the small, hand-held project and then discussing the large, laptop project.

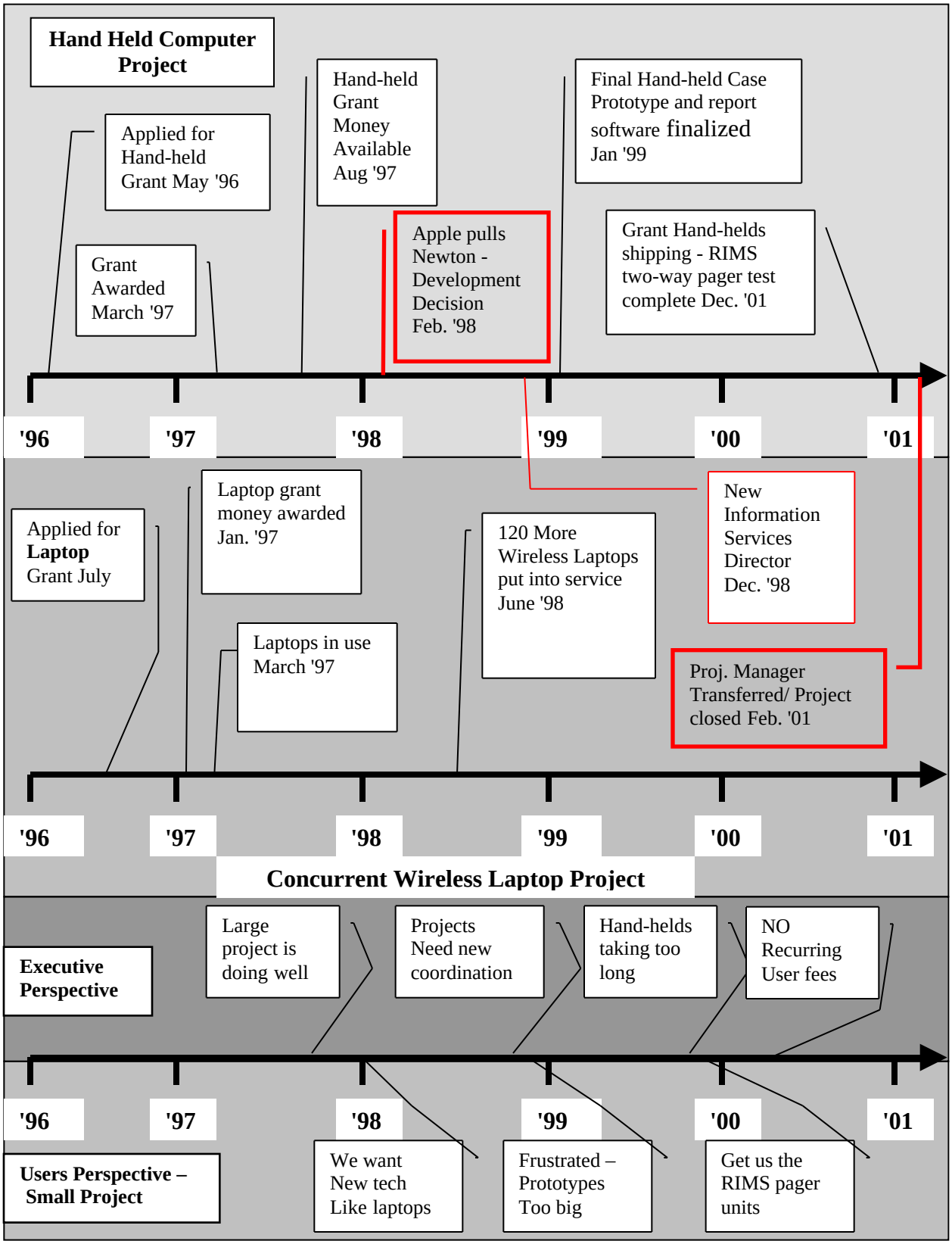

Figure 3. 2: Project Timelines (1996 - 2001)

(September, 1997): Integrator/developer Contract signed

(Small project) The contract with Integral Data Systems was released September 23, 1997. Digital Ocean (the intended hardened handheld supplier) was contacted regarding the availability of twenty units and accessories to include GPS modules and built-in CDPD modems. Digital Ocean units were based on the Apple Newton® 130. Digital Ocean said they were not planning to develop a hardened device based on the newer Newton. This admission set off 'warning bells' since the MessagePad 2100 was such a design leap over any handheld computer on the market and showed that Digital Ocean had no expansion ability.

(Large project) The large case was fully operational and planning expansions. Users were generally very pleased at the fast, query responses and collectively logged tens of thousands of queries per month. Two grants with 129 more units were planned for the following summer (1998).

(October - November 1997): Options considered

(Small project) Throughout the end of October 1997 through November the development of a hardened MessagePad® 2100 from the commercial off-the-shelf product was considered. The characteristics that became important at this stage were type of modem and the resulting battery life implications. There was only one Type II PC card modem at the time. Battery life was poor and the side mounted modem made the device unwieldy. Any commercial product prototype would need to be hardened and designed for another CDPD modem (not yet available in 3rd quarter 1997). A smaller, commercial CDPD modem would have to be procured or the larger, ineffective modem would have to be used. It was now near the end of November 1997 and the 'Go-No Go' decision with the Digital Ocean device had yet to be made.

The project manager failed to differentiate the difficulties for the executive staff between the two projects. Initially both the laptop and hand-held projects were building-block projects where they could use COTS (common off the shelf) components. The large project was to purchase hardened laptops, add commercial middleware, and transfer information over a commercial, cellular data network. The smaller hand-held project was to (initially) buy a hardened COTS hand-helds with built-in modems and use the same commercial data network. The hand-helds would additionally require some additional, simple software written for a

different operating system. During this time the mobile-officers pressed to accelerate the handheld computer project to use "like the regular patrol officers."

(Large project) In the background, the one hundred wireless (CDPD) laptops that had been deployed were working through the software problems and becoming reliable. One hundred and twenty-nine additional wireless laptops were approved to go on line by June 1998. Executives were pleased with the units with the line personnel but the use with administrative units was not as successful.

The difference in complexity was not readily apparent to the executive staff between the large and the 'small' project and was not explained by the project manager. Questions were raised such as: the larger, wireless laptop project was successful in record time so why wasn't the smaller project finished?

(December 1997 - February 1998) Major Project Redesign

(Small project): At this time, neither Integral Data Systems nor the project manager of the Police Hand-held Project felt comfortable using a hardware/software system that (for reasons unknown to them) was having its support pulled by Apple Computer. There were hundreds of emails and many phone calls to the integrator/developer in Maryland at this point but the decision had to be made whether to progress any further on the project or return the unallocated monies. Much of the industry information during this period was fragmentary or conflicting. The integrator, after surveying the market, suggested a Casio handheld that could be easily hardened.

The initial hand-held development track would have been to buy an existing hardened product with a built-in modem. And additional level of complexity was required for the hand-held: several software forms would have been written and optimized to transmit and receive small packets of encrypted data using a 56 bit Digital Encryption Standard (DES 1977). The new development track would be more difficult -- to put together an actual hardened product from off-the-shelf components. The decision to go ahead was complicated and there was a good deal of conflicting information from the administrative hierarchy. The executive staff made no suggestions on how to proceed at this point in a short (<3 minutes to discuss the topic). The discussion left the project manager with the decision to proceed or not but the small project was seen be the executives as just another deployment project instead of a project to develop a new product (as specified in the grant).

- The original hardware purchase was not going to be viable in 1998.
- The device was large for a 'hand-held'. Were there alternatives available?
- It had been 18 months since the original device survey. A six-week survey was conducted to find another suitable platform for development. Telxon was developing some interesting handheld models as were Itronix and Panasonic.
- The newly introduced Palm Pilot was the right form factor but did not have the processing power or auxiliary ports necessary to power a modem at that time.

The options available were:

1. kill the project and face returning the money to the grantee (the major consideration being the politics of angering the executives and the city council, mayor and legal department) due to the extensive effort to approve a federal grant; or

2. 'plunge ahead' and find a new hardened (off-the-shelf) device for development (quick scans showed that hardened devices were out of the price range of the current grant and it would take over an -- estimated --- year to get increased money from the grantee and any increase would have to be approved by the city council), or

3. take a commercial product (CASIO), apply a shock-resistant cover, add an additional battery pack and develop a better CDPD modem with the same integrator (greatly lengthening the project) or

4. use a new integrator (delay of, at least, 9 months to a year) to drop one company contract and award a new contract with approval from grantee.

Ultimately, option "C" was selected contingent upon receiving grantee (and perfunctory administrative) approval. The decision to finally proceed with the project was made during a five (5) minute telephone call between the integrator and the project manager. Executives were not consulted during these exchanges and the project manager was greatly influenced by the effort that had already gone into the project and the (then recent) improvements in reliability and planned expansion of the larger laptop project (Arkes and Blumer 1985; Arkes and Hutzel 2000).

The newly introduced CASIO PA-2400 looked like it 'fit the bill'. The project manager and the integrator had 'some' experience in developing but their experience level would have been considered marginal in hardware product development (White 1978). The decision was made to buy twenty Casio PA-2400s, sub-contract the production of a custom case, add a battery pack in parallel to the manufacturer's original battery. Then the handheld project manager would have to find a commercial modem (using the PC card modem developed for the larger laptop

project but with software to support a handheld operating system). Form development would be in Visual Basic for CE (WinCE®). Two commercial, terminal emulation clients for CE were purchased to test connections to the department Unisys 2200 mainframe for queries. The NIBRS (National Incident Based Reporting System) form was concurrently developed for the Windows CE® platform.

(Large project) The expansion of the laptop project received funding from two grants that would allow one-hundred twenty nine (129) new laptops to be deployed within a few months.

*(Summer – October 1998)**:*** New Background information

(Small project): By June 1998, a crude, hardened case for the handheld was shipped from the ruggedized case developer to test the new form factor. The battery pack and modem were still "under development" meaning that no battery pack had been chosen because the form of the case had not been finalized yet. There were now non-disclosure agreements with a number of vendors to help develop inexpensive CDPD Type II PCMCIA card modems and modem driver software. The electronic forms for the Incident report met Federal standards and a traffic citation was completed as well, in time for a prototype case design (padded, black ballistic nylon). It was now the end of October 1998. Executives thought the prototype was very crude but, at least, showed some progress.

(Large project) The concurrent laptop project had been expanded and one hundred twenty nine more units had been deployed. Color photographs could also be retrieved in less than fifteen seconds along with textural queries. The executive staff was very impressed by the ability to retrieve color photographs.

The Metropolitan Nashville Police Department, using additional grant monies (1998), now had 269 wireless laptops deployed for police officers using the commercial wireless data service (CDPD - Cellular Digital Packet Data). Mugshots (digital photographs of criminal subjects) were now available to officers with wireless laptops with an average retrieval time of fourteen seconds. The recurring cost for the CDPD connections was $49.95 per hand-held/laptop per month (10Mb per user per month of successful data transfer) and was being paid initially through grant monies. Software Corporation of America provided the middleware for the wireless laptops. The significance of this will become evident later when SCA (Software

Corporation of America -- which produced the laptop client -- began making 'noises' about developing for Windows CE).

(End of 1998 to mid-1999): Organizational Changes

The Information Services Director for the Metropolitan Nashville Police Department left for another job and a new director was chosen from within the organization. This signaled a shift from sworn officer support to civilian support for field personnel in both projects.

(Small project) In November 1998 a 3270 Terminal Emulation application and SCA's TCP Redirector™ software was combined to allow the first hand-held prototype to query local, State and Federal National Crime Information Center (NCIC) data but the transmissions were not encrypted sufficiently. This was the first and last weakly encrypted query run at that stage (unencrypted queries were not allowed by Federal regulations). By late November 1998 a firewall had been purchased. SCA, the middleware supplier for wireless laptop software, had agreed to aid in development of a Windows CE based encrypted client to tie-in with their laptop software. A grant extension was requested and granted in January 1999. Executives acknowledged the extension.

It was now early 1999 and a final case prototype had been built by TransportData (a case designer who had been sub-sub-contracted through Integral Data Systems). Long distance control of projects had difficult control problems and this greatly increased uncertainty as to delivery dates (Nicholas 2001). Several supplemental battery packs had been tried and they either supplied marginal voltages over time or had an inconsistent output. A battery had been built and the charger connection through the case had finally been worked out so a user would not have to disassemble the entire unit to charge it daily.

The developed case had the antenna built-in and achieved a considerable signal gain. A unit could be repeatedly dropped from four (4') feet onto concrete without damage. The pen input tool holder was built into the case and it would function with a right or left handed user. Novatel and Sierra Wireless (collaborators with the Metro Nashville Police Department) now produced very stable software drivers for their new modems but the current draw was still high. The new battery pack for the prototype would work but if the user did not exactly connect the battery after a recharge, the internal batteries would be drained within minutes and the unit would lose its

connection. The card slot modems worked well. Novatel introduced the Minstrel Palm CDPD modem about this time. The Minstrel™ modem was an offshoot of this development work.

The prototype device weighed eighteen (18) ounces and was slightly smaller than the original Digital Ocean. Officers polled (informally) requested mugshots in color and indicated they wanted a device the size and weight of "a Palm Pilot but more rugged." The changing user requirements (see Table 3.1 below) were a constant pressure and colored every decision. The only reaction (visible) from the administrative command (superiors) was to ask occasionally, "Where are those devices?" The perceived pressure to complete the project quickly without using police information services was considerable.

Table 3. 1: Changing User Requirements (informal surveys of bike officers)

YEAR	1996-1997	1998 - 1999	2000	2001
Weight	3 pounds	1 pound	8oz	"Not Much"
Size	9.5"x4.5"x2.5"	4.5"x3.1"x.5"	4.5"x3.1"x.5"	"Small"
Battery Life	8.5 hours	8.5 hours	8.5 hours	8.5 hrs+
Screen	3.8" x 2.8" Mono Backlit	3" diagonal Mono Backlit	"Depends on mugshots"	"Color for mugshots"
Connectivity	Continuous CDPD	Continuous CDPD	Continuous whatever	Continuous whatever

The NIBRS CE based Incident Report and Traffic Citation were finalized. They were stable and functioned well. A prototype unit was sent for officers to test and every bike officer that used it said, "The queries are great but it is hard to use. I wouldn't want to take a report on it. The screen is pretty hard to enter data on. I'd like it for the queries on warrants or stolen tags but I don't want to take reports on it. We really need it but it's too big for our belts (user requirements had changed dramatically since the project had started)."

Interestingly, it was during this period that additional critical personnel changes were taking place in the hand-held project. The programmer at Integral Data Systems quit to take another job as soon as the handheld form software was completed. The programmer at SCA also quit to take another job that summer. The SCA ‘beta’ client allowed project personnel to message the case developer in San Francisco using CDPD. Personnel were able to run encrypted (56bit) warrant and tag queries on the new hand-held. The SCA source code was 'uncommented'

(no comments in the code to show what step performed what function so it is harder for another programmer to use). This personnel attrition was a major setback for the hand-held project.

(Large project) The user queries for the 269 wireless laptops numbered tens of thousands a month and productivity was improving with sharp increases in arrests and decreases in targeted crimes (auto theft and armed robberies). Crime decreases were dramatic in auto theft and armed robberies. Executives appeared proud of the accomplishments of the laptop users and considered a grant expansion of five hundred more wireless laptops using a Motorola proprietary data system (integral with a new radio system). The executives, though pleased with the new laptops, were displeased with the monthly recurring charges for the CDPD service that would soon have to be paid out of general operating funds.

*(3rd quarter 1999):*Handhelds—No printing or wireless reporting

(Small project): Infrared printing with the prototype hand-held devices was tested and had proven ineffective outdoors (sunlight was too great even on a cloudy day). Printers had to be battery operated and were either too flimsy or too heavy to be carried by active patrol officers. Printing out a citation for a violator at the scene seemed a remote possibility at this point for solo-motorcycle officers. The Metropolitan Police Department was not going to use ANY wireless reporting in the near future. The Police Information Services Division decided that a case management system needed to be 'up and running' before any wireless reports were to be sent (actually the case management system did not come on line). Hand-helds, in field tests, did not have the necessary resolution to display mugshots (converted digital photographs) on their grayscale screens and photographs would have been unusable but four prototypes were finally available.

(Large project) The two hundred and sixty nine (269) wireless laptops from the large project were producing 40,000 textural queries and thousands of digital photographs (mugshots) transmitted per month. The executive decision to request five hundred (500) additional wireless laptops through another Federal grant was accepted. The proprietary modems for the new system would be $1,525 each with a $25 per month maintenance fee per radio.

Fourth quarter 1999:

(Small project) The integrator and project manager increased email and telephone requests for final production of handheld cases from TransportData (the sub-sub-contractor for cases in San Francisco). The geographical linkage to the developer was too weak (Allen 1977). Verbal and email demands to the case maker went unanswered because 95 % of the contract development funds had been paid to the integrator for the hardware and software. There was approximately $14,000 left in unallocated grant funds at this point.

Prototypes versus a mature system

(Small project)*:* Type II PCMCIA CDPD modems now drew less amperage had dropped in retail price from over $800 apiece to $169 each (the price drop had been predicted by the project manager). Some commercial modems now had a low draw, standby mode. Bike and walking officers displayed their frustration about ever getting workable units. These same officers now unequivocally stated that the prototype units were too large to carry. They stated that they wanted something as small or smaller than a Palm® Pilot®. The terminal emulation application, VB (Visual Basic®) client had severe user interface problems. The use of the prototype was not intuitive and the software keyboard and handwriting recognition was difficult to use.

By the second quarter 2000, eighteen of the cases and assorted battery packs and printers had been shipped to the police department. There were twenty new, Novatel®, modems with the units. The Office of Science and Technology approved another extension of the small project.

DataMaxx and Paradigm4 companies demonstrated a working RIMS 950 "Blackberry" that could perform encrypted state and Federal queries and email. There was $9,753 in uncommitted funds remaining in the grant. Some bike officers tested the RIMS pager units and had difficulty 'learning' the keyboard for special characters. Officers liked the size of the RIMS units and several were 'field tested' but officers disliked the fact that the keyboard could not be seen at night -- making it difficult to use at night.

In the third quarter of 2000, the Office of Science and Technology approved a change in development money allocation and gave tentative approval to purchase 20 RIMS, two-way encrypted pagers. The Planning and Research Division and the police fiscal office negotiated a tentative $38/month charge contingent upon a signed contract. The Chief of Police got a RIMS™

950 unit to test but the supplier never activated the unit. The Chief executive did not approve purchase of the small pager units and the original prototype, though working was difficult to use. The executives did not want any units with recurring monthly charges and the recurring charges for the two-way pagers would be comparable to the laptop charges. Field testing showed the hand-helds and pagers were only one-quarter as effective (productivity improvements) as the existing wireless laptops.

The year 2000 ended with Software Corporation of America becoming a wholly owned subsidiary of Motorola. The Windows® CE® platform sales were still anemic compared to sale of Palm® devices. Motorola started a handheld (Palm, RIMS) development unit. The Project Manager approached police command personnel to buy a RIMS pager system with remaining grant money and perform further field testing. The executives' 'pulse' for further change was never anticipated (Cohen and Levinthal 1990) and they did nothing (inaction is also a decision). This absorptive capacity was a management perspective and an element of risk. The CDPD service for the prototype CASIO units (at $49.95/month/unit) was discontinued due to predictions that street officers would not use the final handhelds in their current form.

(Large project) The information services department had taken over all aspects of the laptop project and was planning the deployment of the new five-hundred (500) wirreless laptops.

(2001): Project "Conclusion"

(Small Project) Uniform street officers approached police command staff to ask for RIMS pager devices since they liked their form and wanted the ability to silently query. Casio units were distributed to administrative staff and the project manager was transferred to a non-technical division. Finally, in the second quarter 2001, the Hand-held Grant was closed. Unallocated money ($9,753.00) was returned to the grantee.

(Large Project) The laptop project continued to be successful in the field.

Overall Results

Different personnel had different views of the results of the projects. The project manager's reason to complete the grant was to recoup the grant match money and give field personnel a useful tool.

- The firewall software ($10,000 plus) was still being used by the police department.
- New Type II CDPD PC Card modems for the Hand-helds replaced damaged card modems in laptops (saving $4,000+).
- National Incident Based Reporting System software became available (free) for any police department in the United States.
- A traffic citation designed for 'Powered by Windows' operating systems became available (free) for police departments in the United States.
- Several companies developed commercial CDPD modems and software benefiting from the experience of the Metropolitan Nashville Police Department. Retail prices for CDPD modems dropped from $800 to $1,000 range to $169 - $319 range.

User (Street Officer) Interface Results:

- Officers did not desire to fill out lengthy forms on small devices.
- Mugshots must be displayed clearly (even in daylight) - preferably in color (officers request thousands of colors or better color depth).
- User interface for officers should be easily mastered.
- Back-lighting of handheld screens at night is a requirement.
- Lighted (or luminescent) keys on two-way pagers are considered a necessity for night use.
- Infrared printing systems did not work outdoors and Bluetooth® devices should be considered.

The technological change (also the market change) in this case was the different (evolution) in operating systems: Newton® OS, Win CE® OS, RIM® OS and the Palm® OS. The Newton® OS disappeared over the course of the project, the Win CE® OS has improved its market share and the RIM® and Palm® systems developed over the course of this project. When the original intent of the project was changed, the uncertainty regarding the operating system and platform became greater and the likely positive outcome became marginal. This increased technological and hindsight bias risk by management. A risk assessment would have shown the

project manager and the executives that the development project was not viable. Management gains would be marginal at best.

Analysis

Conflicting and partial information was clearly shown for this project. Fear of reprisals from executives was a real-world consequence (Miller and Reuer 1996). The intent of the small project was never realized even though the project was “successful” to the letter of the original intent. When compared to the laptop project, hindsight bias by executives produced reevaluations of initial decisions.

In the legal profession there is a body of law regarding the "step in the dark" doctrine (1994). Decisions by the courts state that "a person is at fault, themselves, when that person takes a step when they cannot see where they are going." Is a project manager any different? Decisions made when there are high levels of uncertainty increase consequences. Eisenhardt and Zbaracki (1992) showed that most strategic decisions by individuals were made from incomplete facts and based on bounded rationality and politics. There are real world consequences to decisions and simple rational choice models do not complete the picture for high-risk decisions. It is incumbent on the project manager's to reduce uncertainty and get 'buy-in' (acceptance) from stakeholders (not just end users) when considering any development project (Venkatesh, Speier et al. 2002). A project manager must attempt to employ decision-making from the perspectives of the stakeholders and did not keep executives informed at critical steps in the smaller case (Ashmos, Duchon et al. 1998; Venkatesh, Speier et al. 2002).

In these two cases, the political risk of project failure far outweighed the technological risk. These cases show how upper management reevaluated earlier decisions in the smaller project. Though the risks for the smaller project were financially smaller, the risk of failure was just as real. Hindsight bias should be expected in all projects regardless of project size and hindsight bias by management greatly increases risk to project managers by coloring the executives' perception whether a project is successful or not. Even acknowledging hindsight bias effect does not remove that bias so a project manager must anticipate biased executive decisions. This effect suggests that perspective should be included when modeling risk (Fischoff 1975; Arkes, Wortmann et al. 1981; Kunreuther, Linnerooth et al. 1984; Gioia and Chittipeddi 1991; Goia and Chittipeddi 1991; Klein 1993; Venkatesh, Speier et al. 2002).

Our case studies show that project management decisions were based on the project manager's assessment of the technological and resource driven risks. The strategic decisions, the determinations of project success or failure were dictated by the executive staff (Kumar, Persaud et al. 1996; Balachandra and Friar 1997). The executive staff had very little contact with the project manager regarding long-term projects but did gain project knowledge from others in the executive staff. The initial (small) project schedule was not achieved and schedules were constantly extended. The successful larger project gave a comparison that the (smaller case) development project could not match. Differences between the projects were not detailed to the executives. Information to executives was spotty, at best, for the smaller project of the two because the project manager considered it financially insignificant and other larger projects, with the same project manager, had been very successful. This perception of importance and risk illustrates another dimension of uncertainty in decision-making -- the perspective risk.

Modeling risk from the executive perspective is an additional method to reduce uncertainty. It is this impact of uncertainty (with uncertainty as a hindrance to decision-making) that appears to be a cause for added real-world consequences (risk) in many critical decisions (Fischer 1995). Perspective impacts decision-making (whether involving the rational choice model or naturalistic decision-making) in projects and suggests that project managers should model risk from the 'decision-process perspective' (Kunreuther, Linnerooth et al. 1984). Our case studies are prime examples of how perspective produced uncertainty and added risk. Decisions by individuals are often made in a discrete moment in time, even though there may be a long period of scanning prior to that moment (Culnan 1983). The ability of the organization, accepting a true development perspective, should have been addressed -- their absorptive capacity to the process of change (Cohen and Levinthal 1990). Indeed, a risk analysis from the executive perspective is a known risk in projects. An executive risk analysis should be applied on all projects regardless of size (Kunreuther, Linnerooth et al. 1984). Decisions made from a single perspective can increase risk.

The success (impact) of the concurrent project spurred unrealistic expectations from upper management in the handheld development project. The expectations of upper management (hindsight biases) were risks that had not been anticipated. Nor were the comparisons to the larger, *successful* project. These expectations occurred at a time when the information services section was reducing support to 'extra' projects as they upgraded

conventional desktop hardware and software department-wide. The development support for the wireless laptops was forced to transform to maintenance support and information services support for the hand-held project was removed.

Who were the stakeholders in this project? They were the street officers who would be using the devices and the administrators who would give the final approval. The National Institute of Justice officials were stakeholders because they were looking for commercial developments of products that would eventually aid police. The commercial vendors/developers were stakeholders (by their definition but not by executive staffers) in any product development. The support personnel for police information services must be included because they would support the product life cycle. The project manager did not consider the external system in depth in this case nor the administrative/political consequences. Obviously, multiple stakeholders were involved in this project but the initial grant dealt only with primary user needs and not with secondary needs or administration needs. The key decision for the handheld was made during a phone call in 1997 to discontinue the off-the-shelf project and begin a hardware development project. This project change involved a more difficult software development project (see timeline chart). This was done without also getting a ‘buy in’ approval from upper management (a death knell) from a 'sunk cost' perspective (we've already gone this far and conditions are acceptable) (Bukszar and Connelly 1988; Gioia and Chittipeddi 1991; Doerr and Mitchell 1998; Arkes and Hutzel 2000). The expected extensive delay due to increased project complexity after this point should have been evaluated from a perspective of upper management. The monetary risks were only a component of risk and should have not been the sole consideration.

Upper level management had a different perspective because they were not impacted by the day to day issues pressure from end users and contractors. The executive investment of effort in the hand-held (small) project was minimal and there were few 'sunk cost' influences. Analytical assessment seems fine until we look at the structure of the project as it progressed. Here, upper management was not balancing success solely from a financial outlook, as was the project manager. They were using a hindsight view of the project from brief comments during three (3) hour staff meetings and expected outcome measures (Bukszar and Connelly 1988). They were evaluating how the success or discontinuation of the project would affect their operation. Organizational benefits from success were minimal though there were positive

aspects. Project managers who wish to have their development projects seen as successful should lower their management perspective risk by:

1. Prepare for management perspective changes when a development project is tremendously successful or marginal (hindsight bias will cause them to reevaluate their initial decisions).

2. Present marginal outcomes (proportional success or failure of project goals) since decision framing will affect management's perception depending on the absorptive capacity of that organization (and if they are a risk adverse or risk taking organization).

3. Invoke 'sunk cost' assessments by executives by not isolating management from resource and time expenditures.

Grounded assessments using data collection and developing emergent concepts from those findings and the later 'issue set' analytic approach would have us believe that we just sum the pieces of information and that is our decision (Glaser 1992; Wood 1994). Here, experienced people made decisions with uncertain information. Project managers must plan to educate executives about the problems in projects. A risk assessment by the project manager from the executives' perspective would have helped clarify unarticulated risks by reducing the uncertainty and quantifying the known risks. Executives' hindsight biases might have been reduced if they had been offered the risk assessments as this project unfolded. The 'gain versus loss' estimate should have been accepted by all stakeholders or the project terminated. Reducing uncertainty would make project decisions less a 'step in the dark'.

Future research

Research examining how communication affects decisions based on the role of the decision-maker should be implemented. These case studies do not supply the tools to evaluate perspective decision making bias. These case studies look at only one organization and research should be performed using a broad range of industries. How project managers decide to keep executives informed in projects and the impact of multiple projects should be researched.

References

(1994). Eaton v McClain. 891 S.W.2d, TNN1994**:** 587.

Allen, T. J. (1977). Managing the Flow of Technology. Strategic Management of Technology and Innovation. M. a. W. Burgleman. Cambridge, MA, MIT Press**:** 552.

Arkes, H. and C. Blumer (1985). "The Psychology of Sunk Cost." Organizational Behavior and Human Decision Processes **35**(1): 124 - 140.

Arkes, H. R. and L. Hutzel (2000). "The Role of Probability of Success Estimates in the Sunk Cost Effect." Journal of Behavioral Decision Making **13**(3): 195-306.

Arkes, H. R., R. C. Wortmann, et al. (1981). "Hindsight bias among physicians weighing the likelihood of diagnoses." Journal of Applied Psychology **66**: 252-254.

Ashmos, D. P., D. Duchon, et al. (1998). "Participation in Strategic Decision Making: The Role of Organizational Predisposition and Issue Interpretation." Decision Sciences Journal **29**(1): 25 - 51.

Balachandra, R. and J. Friar (1997). "Factors for Success in R&D Projects and New Product Innovation: A Contextual Framework." IEEE Transactions on Engineering Management **44**(3): 276 - 287.

Bukszar, E. and T. Connelly (1988). "Hindsight Bias and Strategic Choice: Some Problems in Learning from Experience." Academy of Management Journal **31**(3): 628-641.

Cohen, W. and D. Levinthal (1990). "Absorptive Capacity: A New Perspective on Learning and Innovation." Administrative Science Quarterly **35**(1): 128 - 152.

Cole, H., C. Vaught, et al. (1998). "Decision Making During a Simulated Mine Fire Escape." IEEE Transactions on Engineering Management **45**(2): 153 - 162.

Culnan, M. (1983). "Environmental Scanning: the Effects of Task Complexity and Source Accessibility on Information Gathering Behavior." Decision Sciences **14**: 194 - 206.

Daft, R., R. Lengel, et al. (1987). "Message Equivalency, Media Selection, and Manager Performance: Implications on Information Systems." MIS Quarterly **11**(3): 355-366.

Daft, R., J. Sormunen, et al. (1988). "Chief Executive Scanning, Environmental Characteristics, and Company Performance: An Empirical Study." Strategic Management Journal **9**(2): 123 - 139.

Doerr, K. H. and T. R. Mitchell (1998). "The Consequences of Role-conferred Bias and Base-Rate Neglect." Decision Sciences Journal **29**(2): 461 - 478.

Duchon, D., K. Dunegan, et al. (1989). "Framing the Problem and Making Decisions: The Facts are Not Enough." IEEE Transactions on Engineering Management **36**(1): February 1989.

Eisenhardt, E. M. and M. J. Zbaracki (1992). "Strategic Decision Making." Strategic Management Journal **13**(Special Issue): 17-37.

Eisenhardt, K. M. (1989). "Building Theories From Case Study Research." Academy of Management Review **14**(4): 532-550.

Fischer, U., Orasanu, J., Wich, M. (1995). Expert pilots' perceptions of problem situations. Eighth International Symposium on Aviation Psychology, Columbus, OH, Ohio State University Press.

Fischoff, B. (1975). "Hindsight€foresight: The effect of outcome knowledge on judgment under uncertainty." Journal of Experimental Psychology: Human Perception and Performance **1**(3): 288 - 299.

Fox, C. R. and A. Tversky (1998). "A Belief-Based Account of Decision Under Uncertainty." Management Science **44**(No. 7): 879-895.

Gioia, D. A. and K. Chittipeddi (1991). "Sensemaking and Sensegiving in Strategic Change Initiation." Strategic Management Journal **12**(6): 433-448.

Glaser, B. G. (1992). Basics of grounded theory analysis. Mill Valley, CA, Sociology Press.

Kahneman, D. and A. Tversky (1979). "Prospect theory: An Analysis of Decision Under Risk." Econometrica **47**(2): 263 - 291.

Klein, G. (1998). Naturalistic Decision Making by experienced persons. Sources of Power: How People Make Decisions. Cambridge, Massachusetts, The MIT Press**:** 330.

Klein, J. (1993). "Modelling Risk Trade-Off." Operational Research Society **44**(5): 445 - 460.

Kumar, V., A. Persaud, et al. (1996). "To Terminate or Not an Ongoing R&D Project: A Managerial Dilemma." IEEE Transactions on Engineering Management **43**(3): 273 - 284.

Kunreuther, H., J. Linnerooth, et al. (1984). "A Decision-Process Perspective on Risk and Policy Analysis." Management Science **30**(4): 475 - 485.

Lipshitz, R. and O. B. Shaul (1997). Schemata and mental models in recognition-primed decision making. Naturalistic decision making. C. Z. a. G. K. (eds.). Mahwah, N.J., Erlbaum**:** 293 - 304.

Miller, K. and J. Reuer (1996). "Measuring Organizational Downside Risk." Strategic Management Journal **17**(9): 671-691.

Nicholas, J., 2001 (2001). Project Management for Business and Technology. New Jersey, Prentice Hall.

Pate-Cornell, M. E., G. Tagaras, et al. (1990). "Dynamic Optimization of Cash Flow Management Decisions: A Stochastic Model." IEEE Transactions on Engineering Management **37**(3): 203 - 212.

Schmitt, J. F. and G. Klein (1996). Fighting in the fog: Dealing with battlefield uncertainty. Marine Corps Gazette**:** 62-69.

Schweitzer, M. E. and G. P. Cachon (2000). "Decision Bias in the Newsvendor Problem with a Known Demand Distribution: Experimental Evidence." Management Science **46**(3): 404 - 420.

Tversky, A. and D. Kahneman (1981). "The Framing of Decisions and the Psychology of Choice." Science **211**(4481): 453 - 458.

Venkatesh, V., C. Speier, et al. (2002). "User Acceptance Enablers in Individual Decvision Making About Technology: Toward and Integrated Model." Decision Sciences Journal **33**(2): 297 - 316.

Werth, L., F. Strack, et al. (2002). "Certainty and Uncertainty: The Two Faces of Hindsight Bias." Organizational Behavior and Human Decision Processes **87**(2): 323 - 341.

White, G. (1978). "Putting Determinants to the Test of History." Technology Review: 21 - 28.

Wood, D. J. (1994). Business and Society. New York, Harper Collins.

Yin, R. (1994). Case Study Research: Design & Methods. Thousand Oaks, CA, Sage Publications.

CHAPTER IV

WHAT WAS LEARNED

It is clear that there are perspective differences according to the role in the organization of those persons making strategic decisions. What information is gathered for these critical decisions, from whom, and when information is gathered are avenues for future research. Executives appear to use different criteria to define failure than project managers. They appear to be less concerned about gathering more information when a project is about to be terminated also. Executives "count" the work of their subordinates when assessing how much effort *they* have expended for a project. Executives tend to be concerned with the process as it was originally presented to them. They seem very concerned with change.

Project managers appear to narrowly focus on getting an outcome, any positive outcome, as long as it is not over budget. Project managers are unlikely to be "trained out of" overestimating chances of success when they have invested a considerable level of effort. Project managers expect project changes. It would be prudent for these project managers to make initial time estimates very clear and communicate with executives when difficulties might delay a schedule or change a requirement. Project managers should also realize that executives see little difference between a failure in large or small projects.

Limitations

The sample size should be increased and other industries should be examined to look for industries-wide, role based traits.

This research begins to examine these differences that affect terminated technology projects but should be expanded to how these persons communicate information and how decisions are made in successful projects as well. Executives appear to have a broader view (or the perception of having), a strategic view of a project while project managers have a focused, technical view of the project. Understanding these perspective differences may make project continuance decisions less of a step in the dark.

APPENDIX A

Executive Technical Survey

The objective of this survey is to investigate how organizations determine when to terminate a project. A **technical project** is defined as a series of tasks or activities to achieve a specific objective within certain specifications, within defined start and end dates, and is subject to funding limits and resource availability.

Termination of a project is when a project is stopped before it achieves its complete implementation. For example, a technical project that had an objective to add voice recognition to a record keeping department that was stopped after prototype testing would be considered a terminated project.

All of your answers will be kept confidential.

The survey contains four parts:

I. This section inquires about background information about your organization and your role in that organization.
II. This section reviews the various forms of information gathered during a project.
III. This refers to the critical factors in the **termination** of a project
IV. Finally, the factors that are involved in evaluating project importance.

NORMALLY TAKES EIGHT (8) MINUTES TO COMPLETE THIS SURVEY

Part I: Background Information	**All information will be kept confidential.**
Part I-A	What type of organization do you represent (please select the one most appropriate):
Pick the most appropriate type of business.	☐ CITY GOVERNMENT ☐ COUNTY GOVERNMENT ☐ STATE GOVERNMENT ☐ FEDERAL GOVERNMENT ☐ LAW ENFORCEMENT ☐ COMMERCIAL R&D ☐ RETAIL ☐ MANUFACTURER ☐ TECHNOLOGY SUPPORT ☐ OTHER _____
I-B	What is the approximate number of full time employees managed in your organization? _____
I-C	Does your organization implement technical projects? ☐ YES ☐ NO (if no please stop now) If yes, what would you consider a **large project?** More than _____ Dollars($) and More than _____ Full-time people What would you consider a **small** project? Less than _____ Dollars ($) and Less than _____ Full-time people
I-D	How many projects has your organization managed in the past 5 years: _____

PART II of IV (25% Complete Already) PART II CONSISTS of 20 QUESTIONS ABOUT YOUR SOURCES OF INFORMATION

Part II: How important are the following sources of information to you when gathering information about on-going projects within your organization?

Importance Scale
1 -Not important at all

2 - Somewhat unimportant
3 - Mildly unimportant
4 - Neither important or unimportant

5 - Mildly important
6 - Somewhat important

7 - Extremely important
N.A. - Not applicable/unknown

	Importance: Sources of Information for On-going Projects	Importance scale	N.A. UNK
1	**Face-to-face** (Meetings, trips, video-conferencing) *with your project manager*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
2	Face-to-face with employees *in your organization but outside your team*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
3	Face-to-face with *other upper management, including the project champion* . A **project champion** is *an upper management advocate for a project or technology*.	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
4	Face-to-face with *experts in the field outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
5	Face-to-face with *knowledgeable associates outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
6	By **Telephone** with *your project manager*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
7	By Telephone with employees *in your organization but outside your team*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
8	By Telephone with *other upper management, including the project champion*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
9	By Telephone with *experts in the field outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
10	By Telephone with *knowledgeable associates outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
11	By **personally addressed correspondence** (memos, email, letters, talk groups) with *your project manager*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
12	By personally addressed correspondence with *employees in your organization but outside your team*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
13	By personally addressed correspondence with *other upper management* .	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
14	By personally addressed correspondence with *experts in the field but outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
15	By personally addressed correspondence with *knowledgeable associates outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
16	By **general public information** (newspapers, Internet, technical journals) *from your project manager*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.

17	By general public information from employees *within your organization but outside your team*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
18	By general public information *from other upper management*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
19	By general public information from *experts in the field but outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
20	By general public information from *knowledgeable associates outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.

Part II-B: How often do you scan for *information* about **your projects?**

Scanning, in this case, is the action an individual uses to gather information to form opinions to manage their organization.

```
Scanning Frequency Scale

1 - Scan less than once a year
2 - Scan a few times a year
3 - Monthly scan for information

4 - Weekly scan for information
5 - Daily scan for information

N.A. - Not applicable/Unknown
```

	Frequency of scanning as you gather information	Frequency scale	N.A. UNK
21	How often do you normally look for information about your technology or related areas when you are preparing a technology project?	1 2 3 4 5 < NEVER OFTEN >	N.A.
22	How often do you scan for information about your technology or related areas when you are preparing **to terminate a project?**	1 2 3 4 5 < NEVER OFTEN >	N.A.

PART III of IV (50% Complete Already) PART III - CONSISTS of TWO SHORT SECTIONS ABOUT TERMINATED PROJECTS

The remaining parts of the survey deal with projects that have been terminated.

Termination of a project is when a project is stopped before it achieves its complete implementation. For example, a technical project that had an objective to add voice recognition to a record keeping department, that was stopped after prototype testing, would be considered a terminated project.

Consider a **single** project you had to terminate. Think about the termination decision in answering the following questions.

	Scale of the terminated project	Estimate the Size
1	What was the total projected cost of the terminated project?	($) **Dollars**
2	Estimate the total number of full time employees that would have been assigned to this project (from intiation to the deployment stage)?	**# Personnel**
3	Over how many months was the project, that you terminated, supposed to last (from inception to deployment)?	**# Months**

	For the terminated project:	Percent (%)
4	What percent of the total planned man-hours had been spent?	____ %
5	What percent of the total planned budget had been spent?	____ %
6	What percent of the project had been completed?	____ %

	How many man-hours did you spend with the *project manager* during the following phases of the terminated project?	Manhours spent
7	Pre-inception (before the project was begun; conception & planning)	____ manhours
8	At project start-up (the kick-off)	____ manhours
9	Project Development (definition , design phase, and implementation that occurred prior to final month of the project)	____ manhours
10	In the month immediately prior to project termination	____ manhours

	How important were the following *issues* to you concerning the terminated project?	Importance scale	N.A. UNK
11	Level of effort (manhours) already expended *by the project team* .	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
12	Level of effort (manhours) expended in the project *by the project manager* .	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
13	Level of effort (manhours) expended in the project *by upper management*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
14	Amount of money expended on the project to-date (or until end of project)	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
15	Amount of calendar time already used on the project	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
16	Amount of additional money expected to be used to complete the project (anticipated cost overruns).	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
17	Amount of additional manpower expected to be used to complete the project.	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
18	Amount of additional calendar time expected to be used to complete the project	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
19	Potential upper management repercussions toward the termination	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
20	Potential repercussions toward your career	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
21	Potential adverse effects to your end users.	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
22	Potential adverse effect to the project manager's career	1 2 3 4 5 6 7 < LEAST MOST >	N.A.

PART IV of IV (75% Complete Already) LAST PART CONSISTS of 22 QUESTIONS ABOUT THE TERMINATION OF A PROJECT

Part IV: How critical did you feel each of the following factors were on the decision to terminate a project?

```
Importance Scale
 1 - Not important at all
 2 - Somewhat unimportant
 3 - Mildly unimportant

 4 - Neither important or unimportant
 5 - Mildly important

 6 - Somewhat important
 7 - Extremely important
 N.A. - Not applicable/Unknown
```

	Critical Factors In Project Termination	Importance Scale	N.A. UNK
1	Change in initial project expectations (different from what was presented)	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
2	Change in the need for the project by the organization	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
3	Change in overall project complexity	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
4	Change in overall project time to completion (project took too long):	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
5	Change in project users needs (i.e.-customers, user attitude change)	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
6	Change in overall project resources (people, materials, funds)	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
7	Change in technical difficulties	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
8	Change in funding source	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
9	Change in regulatory problems (for example: EEOC, OSHA requirements)	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
10	Issues regarding *internal politics* (within your organization)	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
11	Issues regarding *external* politics (external to your organization)	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
12	Change in overall project importance to the organization:	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
13	Change in commitment by project champion	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
14	Other (please specify-[ ])	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
15	Other (please specify-[ ])	1 2 3 4 5 6 7 < LEAST MOST >	N.A.

Part IV-B: How important was communication with the following *individuals* in the **decision to terminate one of your projects?**

```
     Importance Scale
1 - Not important at all
2 - Somewhat unimportant

3 - Mildly unimportant
4 - Neither important or unimportant

5 - Mildly important
6 - Somewhat important
7 - Extremely important

N.A. - Not applicable/Unknown
```

	Communication with individuals in a decision to terminate a project	Importance scale	N.A. UNK
16	The project manager	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
17	The project team.	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
18	The Project Champion (upper management sponsor), if not yourself.	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
19	Other upper management	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
20	The Chief Executive, if not yourself.	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
21	Yourself as Chief Executive.	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
22	End users	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.

Please add any additional comments:

Click Here to Send Your Responses | Clear All

You will be sending information to ken.pence@vanderbilt.edu.

APPENDIX B

Technical Project Manager Survey

The objective of this survey is to investigate how organizations determine when to terminate a project. A **technical project** is defined as a series of tasks or activities to achieve a specific objective within certain specifications, within defined start and end dates, and is subject to funding limits and resource availability.

Termination of a project is when a project is stopped before it achieves its complete implementation. For example, a technical project that had an objective to add voice recognition to a record keeping department that was stopped after prototype testing would be considered a terminated project.

All of your answers will be kept confidential.

The survey contains four parts:

I. This section inquires about background information about your organization and your role in that organization.
II. This section reviews the various forms of information gathered during a project.
III. This refers to the critical factors in the **termination** of a project
IV. Finally, the factors that are involved in evaluating project importance.

NORMALLY TAKES EIGHT (8) MINUTES TO COMPLETE THIS SURVEY

Part I: Background Information	**All information will be kept confidential.**
Part I-A	What type of organization do you represent (please select the one most appropriate):
Pick the most appropriate type of business.	☐ CITY GOVERNMENT ☐ COUNTY GOVERNMENT ☐ STATE GOVERNMENT ☐ FEDERAL GOVERNMENT ☐ LAW ENFORCEMENT ☐ COMMERCIAL R&D ☐ RETAIL ☐ MANUFACTURER ☐ TECHNOLOGY SUPPORT ☐ OTHER [ ]
I-B	What is the approximate number of full time employees managed in your organization? [ ]
I-C	Have you ever managed a project? ☐ YES ☐ NO (if no please stop now) If yes, what would you consider a **large project?** More than [ ] Dollars($) and More than [ ] Full-time people What would you consider a **small** project? Less than [ ] Dollars ($) and Less than [ ] Full-time people
I-D	How many projects have you managed in the past 5 years: [ ]

PART II of IV (25% Complete Already) PART II CONSISTS of 20 QUESTIONS ABOUT YOUR SOURCES OF INFORMATION

Part II: How important are the following sources of information to you when gathering information about on-going projects within your organization?

Importance Scale
1 - Not important at all

2 - Somewhat unimportant
3 - Mildly unimportant
4 - Neither important or unimportant

5 - Mildly important
6 - Somewhat important

7 - Extremely important
N.A. - Not applicable/unknown

	Importance: Sources of Information for On-going Projects	Importance scale	N.A. UNK
1	**Face-to-face** (Meetings, trips, video-conferencing) *with members of your project team*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
2	Face-to-face with employees *in your organization but outside your team*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
3	Face-to-face with *other upper management, including the project champion* . A **project champion** is *an upper management advocate for a project or technology.*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
4	Face-to-face with *experts in the field outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
5	Face-to-face with *knowledgeable associates outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
6	By **Telephone** with *members of your project team*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
7	By Telephone with employees *in your organization but outside your team*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
8	By Telephone with *other upper management, including the project champion*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
9	By Telephone with *experts in the field but outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
10	By Telephone with *knowledgeable associates outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
11	By **personally addressed correspondence** (memos, email, letters, talk groups) with *members of your project team*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
12	By personally addressed correspondence with *employees in your organization but outside your team*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
13	By personally addressed correspondence with *other upper management, including the project champion*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
14	By personally addressed correspondence with *experts in the field but outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
15	By personally addressed correspondence with *knowledgeable associates outside your organization*	1 2 3 4 5 6 7 < LEAST MOST >	N.A.

16	By **general public information** (newspapers, Internet, technical journals) *from people within your project team*	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
17	By general public information from employees *within your organization but outside your team*	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
18	By general public information *from other upper management, including the project champion*	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
19	By general public information from *experts in the field but outside your organization*	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
20	By general public information from *knowledgeable associates outside your organization*	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.

Part II-B: How often do you scan for *information* about **your projects?**

Scanning, in this case, is the action an individual uses to gather information to form opinions to manage their organization.

```
Scanning Frequency Scale

1 - Scan less than once a year
2 - Scan a few times a year
3 - Monthly scan for information

4 - Weekly scan for information
5 - Daily scan for information

N.A. - Not applicable/Unknown
```

	Frequency of scanning as you gather information	Frequency scale	N.A. UNK
21	How often do you normally look for information about your technology or related areas when you are preparing a technology project?	1○ 2○ 3○ 4○ 5○ < NEVER OFTEN >	○ N.A.
22	How often do you scan for information about your technology or related areas when you are preparing to **terminate a project?**	1○ 2○ 3○ 4○ 5○ < NEVER OFTEN >	○ N.A.

PART III of IV (50% Complete Already) PART III - CONSISTS of TWO SHORT SECTIONS ABOUT TERMINATED PROJECTS

The remaining parts of the survey deal with projects that have been terminated.

Termination of a project is when a project is stopped before it achieves its complete implementation. For example, a technical project that had an objective to add voice recognition to a record keeping department, that was stopped after prototype testing, would be considered a terminated project.

Consider a **single** project that was terminated. Think about the termination decision in answering the following questions.

	Scale of the terminated project	Estimate the Size
1	What was the total projected cost of the terminated project?	☐ **($) Dollars**
2	Estimate the total number of full time employees that would have been assigned to this project (from intiation to the deployment stage)?	☐ **# Personnel**
3	Over how many months was the project, that was terminated, supposed to last (from inception to deployment)?	☐ **# Months**

	For the terminated project:	Percent (%)
4	What percent of the total planned man-hours had been spent?	____ %
5	What percent of the total planned budget had been spent?	____ %
6	What percent of the project had been completed?	____ %

	How many man-hours did you spend with *upper management* during the following phases of the terminated project?	Manhours spent
7	Pre-inception (before the project was begun; conception & planning)	____ manhours
8	At project start-up (the kick-off)	____ manhours
9	Project Development (definition , design phase, and implementation that occurred prior to final month of the project)	____ manhours
10	In the month immediately prior to project termination	____ manhours

	How important were the following *issues* to you concerning the terminated project?	Importance scale	N.A. UNK
11	Level of effort (manhours) already expended *by the project team* .	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
12	Level of effort (manhours) expended in the project *by yourself as project manager* .	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
13	Level of effort (manhours) expended in the project *by upper management*	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
14	Amount of money expended on the project to-date (or until end of project)	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
15	Amount of calendar time already used on the project	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
16	Amount of additional money expected to be used to complete the project (anticipated cost overruns).	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
17	Amount of additional manpower expected to be used to complete the project.	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
18	Amount of additional calendar time expected to be used to complete the project	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
19	Potential upper management repercussions toward the termination	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
20	Potential repercussions toward your career	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
21	Potential adverse effects to your end users.	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
22	Potential adverse effect to the chief executive's career	1 2 3 4 5 6 7 < LEAST MOST >	N.A.

PART IV of IV (75% Complete Already) LAST PART CONSISTS of 22 QUESTIONS ABOUT THE TERMINATION OF A PROJECT

Part IV: How critical did you feel each of the following factors were on the decision to terminate a project?

Importance Scale
1 - Not important at all
2 - Somewhat unimportant

3 - Mildly unimportant
4 - Neither important or unimportant

5 - Mildly important
6 - Somewhat important
7 - Extremely important

N.A. - Not applicable/Unknown

	Critical Factors In Project Termination	Importance Scale	N.A. UNK
1	Change in initial project expectations (different from what was presented)	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
2	Change in the need for the project by the organization	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
3	Change in overall project complexity	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
4	Change in overall project time to completion (project took too long)	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
5	Change in project users needs (i.e.-customers, user attitude change)	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
6	Change in overall project resources (people, materials, funds)	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
7	Change in technical difficulties	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
8	Change in funding source	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
9	Change in regulatory problems (for example: EEOC, OSHA requirements)	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
10	Issuses regarding *internal politics* (within your organization)	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
11	Issues regarding *external* politics (external to your organization)	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
12	Change in overall project importance to the organization	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
13	Change in commitment by project champion	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
14	Other (please specify - [ ])	1 2 3 4 5 6 7 < LEAST MOST >	N.A.
15	Other (please specify - [ ])	1 2 3 4 5 6 7 < LEAST MOST >	N.A.

Part IV-B: How important was communication with the following *individuals* in the **decision to terminate one of your projects?**

```
     Importance Scale
1 - Not important at all
2 - Somewhat unimportant

3 - Mildly unimportant
4 - Neither important or unimportant

5 - Mildly important
6 - Somewhat important
7 - Extremely important

N.A. - Not applicable/Unknown
```

	Communication with individuals in a decision to terminate a project	Importance scale	N.A. UNK
16	Your own input as project manager	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
17	Members of the project team.	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
18	The Project Champion (upper management sponsor)	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
19	Other upper management	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
20	Yourself as Chief Executive.	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.
21	End users	1○ 2○ 3○ 4○ 5○ 6○ 7○ < LEAST MOST >	○ N.A.

Please add any additional comments:

Click Here to Send Your Responses | Clear All

You will be sending information to ken.pence@vanderbilt.edu.